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Hart, Schaffner & Marx Prize Essays

XXVII

THE RESULTS OF MUNICIPAL ELECTRIC LIGHTING IN MASSACHUSETTS

THE RESULTS OF MUNICIPAL ELECTRIC LIGHTING IN MASSACHUSETTS

BY

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TO

THOSE WHO ARE

SINCERELY SEEKING THE TRUTH

ON QUESTIONS OF PUBLIC POLICY

THIS BOOK IS DEDICATED

BY

THE AUTHOR

PREFACE

THIS series of books owes its existence to the generosity of Messrs. Hart, Schaffner & Marx, of Chicago, who have shown a special interest in trying to draw the attention of American youth to the study of economic and commercial subjects. For this purpose they have delegated to the undersigned committee the task of selecting or approving of topics, making announcements, and awarding prizes annually for those who wish to compete.

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PREFATORY NOTE

THE author takes this opportunity to acknowledge specifically his obligations to a number of friends who have critically read the manuscript of this book, either wholly or in part. Professor Harry E. Clifford, of the Electrical Engineering Department of Harvard University and of the Massachusetts Institute of Technology, has given special attention to the technical portions. Mr. Henry B. Sawyer, of the Stone & Webster Organization, has looked particularly over the financial parts of the book, and has generously extended the facilities of the firm to the writer. Mr. Alonzo R. Weed, Chairman of the Massachusetts Board of Gas and Electric Light Commissioners, has read the manuscript throughout, with special reference to questions of law and regulation; and General Morris Schaff, also of the Commission, has taken great interest in the work.

From all of these, helpful suggestions and many courtesies have been received, but especially from Professor Charles J. Bullock, Chairman of the Department of Economics at Harvard, who has given careful, constructive criticism at various stages. Mention should also be made of the kind assistance, both direct and indirect, rendered by Dean Edwin F. Gay, of the Harvard Graduate School of Business Administration, while the writer was carrying on the local survey of the lighting plants herein studied. To the hosts of others who have at one time and another been consulted, a general reference is made in the Introduction. For matters of opinion and methods of presentation, however, the author must assume full responsibility.

Finally, grateful acknowledgment is due the publishers for the consideration which they have shown and the expedition with which they have prepared for the public a book which presents an unusual number of typographical difficulties.

THE AUTHOR

WASHINGTON, D.C.
August, 1918

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INTRODUCTION

HAVING read laboriously through a great mass of the writing which has appeared upon the subject of State industries during the last twenty-five years, the writer is amazed at the futility of most of the attempts to prove or disprove the desirability of public ownership. Many who have made some study of the data necessary for comparative purposes have entered upon the task with strong prepossessions and prejudices, and have accordingly seemed to find the conclusions which they had hoped to reach. Some have grievously ignored many significant considerations; while others have endeavored to particularize too minutely or to prove too much. The more careful his study, however, the less inclined is the investigator to draw sweeping conclusions, and the more ready will he be to do full justice to both sides of the argument.

Probably the day has passed for seriously debating the feasibility of public ownership or operation of those enterprises which directly involve the health and safety of a community. Yet there remains a large group of industries which are carried on primarily as commercial undertakings. Of this group, electric lighting is the only business which has thus far been generally attempted by public bodies in the United States. As to whether the public should engage in other forms of activity, particularly the agencies of communication and transportation, the discussion in the future will doubtless be carried on with increasing intensity. In the meantime the experience which the United States is gaining in the operation of our railroads, and telephone and telegraph systems as a result of abnormal war conditions, will furnish us with some light on the possibilities of a nationalization of these industries.

As municipal electric lighting is now a well-seasoned business in this country, it affords the most fruitful field for an investigation of the results of public ownership. Hence the writer, wholly impartial, holding no brief for either side, has selected for the present comparative study one small portion of the field — Municipal Electric Lighting in Massachusetts. This selection is made because of the fact that probably for no other public industry in the United States is it possible to secure even reasonably comparable data over a period of years, and adequate records for the purpose are to be found only in the State of Massachusetts.[1] The aim of this book is to suggest and exemplify those methods of approach and investigation which may most profitably be followed in future studies of the problems of municipal or state ownership, rather than to make any startling contributions to an already overworked field.

Most of the statistical data on which the computations for this study are based, have been gathered laboriously from the *annual returns* filed with the Massachusetts Board of Gas and Electric Light Commissioners by the individual electric plants, as well as from numerous other State documents. None of the work at any stage has been delegated to others. In making his selections, the writer has carefully examined the returns of about 100 municipal and company plants for the ten-year period 1905–15. Of these, 72 plants, all 39 of the former and 33 of the latter, form the basis of this study. Unfortunately the returns are, for such comparison as is here attempted, distressingly inadequate. Absolutely no data are worked out, and not

[1] Useful data for a much more extensive though probably less conclusive study are being secured in connection with the 1917 Census of Central Electric Light and Power Stations in the United States, on which the writer is now serving as the expert in charge. Some interesting analyses of the available material will be made in the Fourth Quinquennial Report of this industry, which is being compiled by the author of the present book and which should be published during the coming year.

a single relation is deduced. Only the rawest of raw material is given. This fact has necessitated a rather involved series of computations. Countless mathematical operations were needed in order to get the data in such shape that relations could be determined and arranged for presentation.

Furthermore, in a majority of instances, the returns, particularly of the municipal plants, have been revised and corrected by a mass of detailed correspondence between the Board and the separate plants. All of this correspondence, which in many cases exceeds in volume the returns themselves, has been carefully noted. To add to the difficulties of the student, the returns, even after this auditing by the Board, have frequently been found to be exasperatingly inconsistent with themselves or with those of the preceding or following years. This has been particularly true with regard to some of the engineering data, and the figures for the connected load and the output and disposal of current. Under these circumstances the writer has occasionally found it necessary to use his best judgment in interpreting this material in the light of all the data available. In many cases the simple information required has been absent altogether. Mention will be made of all these irregularities as they arise in course of the discussion. Finally, many highly important data are not at present called for by the Board.

The Annual Reports of the Board have been of practically no use in this part of the investigation. In them only the barest general summaries of a few items in the returns are given. And even this material is frequently inaccurate, not because it has been incorrectly transcribed from the returns, but because the data in the returns themselves are incorrect or inconsistent and have not been checked up. Needless to state, the data for gas companies have been somewhat more carefully worked out. It must not, however, be inferred that the writer speaks thus

frankly for the sake of criticizing the admirable work of the Massachusetts Board of Gas and Electric Light Commissioners. Rather, he merely wishes to suggest some of the difficulties which are bound to beset any one who attempts to make a careful study of the records in such a subject as this.[1]

But a study of this sort lacks life and fails to command the full confidence of the public, if it has consisted only of an interpretation of the documents which are filed away in musty public archives, invaluable though they be. The desirability of a personal, first-hand knowledge of the various plants studied, a close acquaintance with the local background, became increasingly evident to the writer as his work progressed. Accordingly, after having thoroughly and sympathetically analyzed the recorded data for each plant, after having secured from all sources available the information which is significant, and after having carefully studied many of the fundamentals of the electric lighting business, both theoretically and from a practical point of view, as revealed by typical plants which are not on the present list, he arranged a painstaking survey of the plants under consideration.

The methods used in carrying on this portion of the investigation are fully set forth in the proper place.[2] Suffice it to say in this connection, however, that the 18 municipal plants in the State which, prior to 1915, generated current, were visited, as well as most of the corresponding group of companies. In addition, the writer went to a reasonable number of the purchasing plants under both forms of management. And, finally, by means of schedules, extensive correspondence, and conversation with those in a position to know, information was secured

[1] In fairness it should be said that recently a few changes and improvements have been introduced in the return forms and in the yearly reports, in accordance with suggestions which the writer has from time to time made.

[2] Chapter x.

regarding the less important plants, which it was not possible, and probably not necessary, to inspect in person.

For the most part the data thus secured have been discussed separately. The conclusions reached through this portion of the study have been further tested by the facts already known, and have in turn served as a check upon the deductions drawn from more purely statistical sources. Conducting the survey without prejudice, the writer was pleasantly surprised to find how closely the results arrived at by the different methods correspond.

From time to time it has been necessary to consult a number of Massachusetts State Bureaus in order to obtain information not in published form as well as to receive suggestions regarding the correctness of some of the writer's deductions. Among these may be mentioned the Bureau of Statistics, the Waterways and Public Lands Commission, the Highway Commission, the departments of the Secretary of the Commonwealth, the Tax Commissioner, and the State Forester, and the Industrial Accident Board. Certain information has also been obtained from the Federal Census Bureau at Washington.

The writer is greatly indebted to the Massachusetts Board of Gas and Electric Light Commissioners for the courtesy which they have shown in answering his numerous questions and giving him access to the documents in their possession. Also, at various stages of his work, he has conferred with or written to a long list of persons who are thoroughly conversant with some phase of the subject under investigation, including men who are actively engaged in private or public electric light and power business, electrical engineers, public utility experts, accountants, lawyers, professors, municipal officials, and members of State commissions. To all of these, many of whom have contributed valuable suggestions or have confirmed the interpretations developed in this study, a general acknowledgment is here made.

Separate mention should be made of the debt which the writer owes to the managers of the municipal electric light plants in the State as well as to the officers and managers of the numerous private plants visited for purposes of comparison. Had it not been for the interest which many of them have taken in the investigation and the personal kindness received at their hands, it would have been impossible to secure some of the most important information included in the present study.

Finally, it is but fair to state that, whatever the author may owe to others for information regarding the *facts* involved, he has been absolutely independent in his method of handling the material at his disposal and in drawing conclusions therefrom. When the *truth* about public ownership is so beclouded by a mass of conflicting evidence and biased opinion, and when so many personal interests are at stake, it behooves the scientific student to weigh well his thoughts and to state as a fact only that which he has carefully verified; but, having taken these precautions, he should speak out boldly, no matter whose ox is gored. Accordingly, the writer himself assumes full responsibility for the findings herein presented, and trusts that the subject has been so handled that the reader will be convinced of the fairness of the conclusions which are reached.

Note to Readers: In conclusion it may be helpful for the writer to suggest those portions of this study which can be read to most advantage by the different classes of readers, for not every one has the leisure required for mastering the details of a scientific book. The general reader will be most interested in chapter XIV, which broadly summarizes the more important conclusions, in chapters X to XIII, inclusive, in which the results of the Local Survey are discussed, and possibly in the summaries at the end of chapters V to IX, inclusive. The more careful student of affairs will no doubt wish to add chapters I to III, and probably chapter IX

and the summary at the end of chapter IV. Accountants will doubtless find some food for thought in chapters V to VIII, engineers may be particularly interested in chapter IV, while public utility experts will naturally turn to all of the chapters from IV to VIII. These three classes, also, should find it profitable to examine the Statistical Appendix. But active men in public or in private electric light and power business, as well as commissioners and thorough students of public finance, will do well to read all of the chapters consecutively, in order fully to appreciate the nature of the problems involved and the significance of the conclusions reached.

THE RESULTS OF MUNICIPAL ELECTRIC LIGHTING IN MASSACHUSETTS

CHAPTER I

A SURVEY AND CRITICISM OF THE LITERATURE ON THE SUBJECT OF MUNICIPAL ELECTRIC LIGHTING IN THE UNITED STATES

THOUGH the first municipal electric lighting plant in the United States began to operate in 1881,[1] it was more than ten years later before students of public questions began to take any marked interest in this form of public activity. For the entire electrical industry this was a period of experiment — a time when, according to the well-known dictum of the economists, it was obviously most unwise for public authorities to risk the money of the taxpayers. Yet, probably due to the fact that many of the smaller towns could not offer sufficient inducements to private capital,[2] the increase in number of publicly owned stations was comparatively rapid. In 1892, so far as it can be ascertained, the entire number was 235, or 16.2 per cent of all central stations in the country.[3] Ten years later we find an increase of almost 250 per cent, to 815, or 22.5 per cent of the total; [4] while at the end of twenty years, in 1912, the number stood at 1562, 29.9 per cent of the total, an increase of 565 per cent for the period.[5] The number of private

[1] Central, 1902: 7; but cf. *Mun. Monop.*: 203–204.
[2] *Ibid.*, 1902: 13; 1907: 28. [3] *Ibid.*, 1902: 7. [4] *Ibid.*
[5] *Ibid.*, 1912: 17. Though exact figures are not available, it is probable that the number is at present 20 or 25 higher than here given. Cf. McGraw, and Thompson.

plants, on the other hand, increased from 1,219 in 1892[1] to 2,805 in 1902,[2] and 3,659 in 1912,[3] a growth of 130 per cent for the ten-year period and of only 200 per cent during twenty years.[4]

Lest the foregoing figures should be misleading, some further comparisons and explanations are called for in this connection. In the first place, on account of the frequent combination and amalgamation of private plants during the past fifteen years or more, the census reports at a given time fail to show the real addition in numbers over a period of years. Also, in some cases, data have been returned as if for a single station when in reality they covered a group of separate plants operated by a single management.[5] Needless to state, these restrictions do not apply in the case of municipal plants.

Here, further, we must observe that, while the number of municipal plants was increased by 310 during the period 1907–1912, a growth of about 25 per cent, the increase in the number of company plants between these dates was less than 6 per cent. This difference points to some rather important conclusions. The private plants appear to have been aware of the great advantages usually to be gained from consolidation and large-scale operation in the electric light and power business, and to have acted accordingly. The public plants, on the contrary, have, from the very nature of the case, been unable or unwilling to follow this policy. They have been prevented, no doubt, by local jealousies, by the fact that they are often widely scattered,

[1] Central, 1902: 7; but cf. *Mun. Monop.*: 203–204.

[2] Cf. *ibid.*, 1902: 3, 6, 158; 118 central stations operating in connection with street railways are not included in the number given.

[3] *Ibid.*, 1912: 17, 18; 169 stations operated by street railways are not included.

[4] To complete the data for the electric light and power business in the United States, the isolated stations, probably amounting to 75,000 should be added. Cf. Central, 1902: 3; 1907: 14; 1912: 17; also Census, N.Y., 1890; 242.

[5] Central, 1907: 28; 1912: 15, 20; U.S. Labor, XIV: 530.

and perhaps by legal difficulties. Accordingly, though the merging of the former has been very frequent, there is a record of only five such cases among the latter during the years 1902–1912.[1] As a result of the present war conditions, the incentives to combination have doubtless been increased to such an extent that there are now, in all probability, fewer independent, privately owned central stations than in 1912.

Nor should we overlook the fact that, in 1902, 82.3 per cent of the municipal plants were in towns having less than 5,000 population, while in 1912 the percentage had risen to 85.1;[2] in spite of the very considerable growth in population within the period which had elapsed. This fact, of course, clearly indicates that municipalization of the industry is being confined in the main to the very small places, where frequently private concerns have not cared to go, and where the problems of operation are comparatively simple.[3] Hence it is reasonable to infer that most of the territory which seemed desirable, so far as private capital is concerned, has been for some time developed — another cause for the less rapid increase in the number of private plants.

Again, it is interesting to note that, while the investment in municipal plants was, in 1902, 4.4 per cent of the total for both groups,[4] it had declined in 1912 to 3.5 per cent,[5] a proportionate decrease of 20.5 per cent, in spite of a proportionate increase in numbers of 33 per cent. Likewise the kilowatt hours output of the public plants decreased from 7.8 per cent of the total in 1902[6] to only 4.7 per cent in 1912, a proportionate decrease of 42.3 per cent.[7] These relations appear clearly in the accompanying table.

[1] Cf. *ibid.*, 1907: 29, and 1912: 22. [2] *Ibid.*, 1912: 23.

[3] The recent municipalization of the Cleveland plant is a conspicuous exception. It must be remembered, however, that this plant serves only a part of the city. [4] Central, 1902: 6.

[5] *Ibid.*, 1912: 66. [6] *Ibid.*, 1902: 6. [7] *Ibid.*, 1912: 17.

Table 1. Comparative Data regarding Private and Municipal Central Electric Stations in the United States

Item	1892		1902		1912		Per cent of increase 1902 to 1912	
	Private	Municipal	Private	Municipal	Private	Municipal	Private	Municipal
Number of stations . . .	1,219 (?)	235 (?)	2,805	815	3,659	1,562	30.4	91.7
Per cent of total. . . .	83.8	16.2	77.5	22.5	70.1	29.9	. . .	. . .
Total investment (construction accounts).	?	?	$482,719,879	$22,020,473	$2,098,613,122	$77,065,144	334.6	250.0
Per cent of total. . . .	. . .	. . .	95.6	4.4	96.5	3.5	. . .	. . .
Output of station (kilowatt hours)	?	?	2,311,146,676	195,904,439	10,995,436,276	537,526,730	375.8	174.4
Per cent of total. . . .	. . .	. . .	92.2	7.8	95.3	4.7	. . .	. . .
Kilowatt capacity of dynamos	. . .	. . .	1,098,855	113,380	4,766,012	368,677	333.7	225.2
Per cent of total. . . .	. . .	. . .	90.6	9.4	92.8	7.2	. . .	. . .

Finally, attention should be called to the fact that 170 private plants were transferred to public ownership before 1902;[1] 113 additional transfers were made between 1902 and 1907;[2] and 106 more between the latter date and 1912.[3] On the other hand, while only 13 municipal plants changed to private ownership before 1902,[4] and perhaps as many more were abandoned,[5] there is a record of 38 more cases of this sort between 1902 and 1907;[6] and a still more marked increase of 97 transferred and abandoned stations during the next period of five years.[7] [8]

With these general data as an introduction, it will be the purpose of this chapter to review briefly the numerous attempts which have been made to compare public and private electric lighting and power business in the United States, as well as to indicate sources which may be useful for such purposes. The first compilation sufficiently extensive to be of much use was made by the United States Bureau of the Census in 1890, under the direction of Allen R. Foote.[9] Though at this time there were about 800 central stations in the country, of which more than 100 were publicly owned,[10] the survey was confined to the 139 private plants in the State of New York, — no data being

[1] Central, 1902: 7, 8. [2] *Ibid.*, 1907: 28.
[3] *Ibid.*, 1912: 22. [4] *Ibid.*, 1902: 13.
[5] Francisco, 1900: 22–28 (also Grant and Marston).
[6] Central, 1907: 29.
[7] *Ibid.*, 1912: 22. These changes are shown in the following table: —

TABLE 2. CHANGES IN OWNERSHIP

Character of Change	*Before 1902*	*1902–1907*	*1907–1912*
From private to public	170	113	106
From public to private	13	33	30
Public plants gone out of operation	18 (?)	5	17

[8] In addition it is probable that from 75 to 100 plants formerly producing their current, are now operating only their distributing system, thus losing a large part of their investment. Cf. Central, 1912: 48 (also Grant and Marston).
[9] Census, N.Y., 1890: 239–265. [10] *Ibid.*: 249.

returned for the lone municipal plant of Dunkirk. Some data are given regarding the capital account; incomes and expenditures are roughly summarized; and no record is made of interest or depreciation. Stations are rudely classified with respect to the kind of power used, the type of engines installed, and the candle power of their lamps. The report affords merely an historical interest to the student, as it was the first effort made by the public to find out about an industry already ten years old. Almost ten more years were to elapse before a second survey was made.

In 1894 there appeared a book on "Electric Lighting Plants," by W. J. Buckley, a salesman for an electrical concern. A good deal of interesting information is given regarding the cost and operation of central stations based on data received from most of the plants in this country and Canada. Among other things he states that the average depreciation of a plant is about 8.7 per cent yearly;[1] that the cost of fuel averages 30 per cent of the total maintenance account,[2] and the cost of labor 36 per cent.[3] He tabulates brief reports from more than 50 municipal plants and from twice as many private stations,[4] without, however, attempting to draw any particular conclusions. An observation is made to the effect that the larger the city, under municipal ownership, the greater is the proportionate cost of maintenance.[5] Finally, it is noticeable that no interest or depreciation is charged against the municipal plants cited.

In the latter part of the same year a report by Horatio A. Foster, electrical engineer and accountant, was published in the "Electrical Engineer."[6] This report was based upon the replies to a uniform letter, accompanied by a carefully prepared schedule, which was sent by the editor, T. C. Martin, to the officials of 150 public plants. Though it was avowedly an impartial attempt to ascertain whether

[1] Buckley: 5, 6. [2] *Ibid.*: 11. [3] *Ibid.*: 18.
[4] *Ibid.*: 5, 6, 250–255. [5] *Ibid.*: 248. [6] *Elec. Eng.*, XVIII: 181–189.

the advantages ascribed to municipal ownership had been "assumed rather than proved," only 42 blanks were returned. From the scanty data thus received, many of the returns being only partially filled, it was clear that the public bookkeeping was in a bad state. Only 2 plants made allowance for depreciation, and only 17 made any effort to compute interest upon their debt, the average rate being about 5 per cent.

After carefully analyzing his meager material, Foster reaches conclusions which may be summarized as follows: (*a*) the labor cost is somewhat less than that of private plants; (*b*) the investment cost per kilowatt capacity of the public plants is no higher than that of the average private plant of like size; (*c*) at least half of the plants studied are in places too small to support a private plant. So far as rates are concerned, he finds that (*d*) the 14 comparable public plants charge considerably more for current than do private ones. And, finally, (*e*) after charging against the commercial income from whatever source, if such there be, interest on the *total* investment and depreciation at 7.5 per cent, in addition to the operating expenses, he estimates the *real* cost of street lighting to be higher than the rates charged for similar service by companies, and highest in the case of those municipal plants which do a commercial lighting business, for which the rates, as he thinks, are usually put too low.

Though no account is taken of the taxes lost by the town which owns its plant, as well as of a number of other items which might reasonably be included in the cost, the high rate of depreciation will offset the omissions, as well as the interest rate allowed, 6 per cent, which may be in some cases too high. Upon the whole, however, he is to be commended for his fairness and orderly method of investigation. Needless to say, such inadequate data are practically worthless for comparative purposes. Yet, since under the circumstances the most prosperous public plants probably

made returns, it is certain that private business suffered nothing in comparison.

In 1895 M. J. Francisco, a man of considerable experience in the electrical business, published a booklet entitled "Municipal Ownership: Its Fallacy," [1] in which, after studying about forty plants from all parts of the country,[2] he concludes that municipal ownership is a decided financial failure when depreciation, interest on total investment, and other items are taken into account. In the first edition, as well as in the later ones of 1898 and 1900, he endeavors to compare the cost per lamp hour and the number of candle power per hour furnished for one cent in the two classes of plants — a most elusive sort of comparison when one realizes the vagaries of "rated" candle power, even at the present time. In the 1900 edition he attempts some sweeping comparisons between 154 public and 222 private plants.[3] He further gives a list of 31 municipal plants sold or abandoned;[4] and he is so constantly asserting that public plants are in places too small to offer paying business to private enterprise,[5] that one feels inclined to wonder why he attempted to make any comparisons at all if matters really stood thus. Upon the whole, Francisco is so bitter against every form of public ownership, assuming that practically every official is either a crook or an ignoramus, he presents his material in such a disorderly manner, and takes the reader so little into his confidence, that his well-meant efforts might be passed over in silence, were it not for the fact that for ten years he secured a good deal of attention from both the opponents and the advocates of state industry.[6]

[1] As the writer has been unable to find a copy of this edition, his first-hand impressions are gained from a study of the later and more complete editions of 1898 and 1900.

[2] Cf. *Mun. Monop.*: 70–71.

[3] Francisco, 1900: 39–43.

[4] *Ibid.*: 22–28.

[5] *Ibid.*: 32–57.

[6] Cf. the virulent criticisms of Commons, in *Mun. Monop.*: 55–180, *passim;* also Parsons, in the *Arena, infra.*

It next becomes our unpleasant task to mention one of the most erratic investigations of the subject that has ever been made, that of Professor Frank Parsons, of Boston University, who burst into print with a truly astounding series of articles on "The People's Lamps," appearing in four numbers of the "Arena" in 1895. While it appears that he had carefully studied many of the technical features of the business, and while he went to an enormous amount of work to secure data from about 200 public plants, his ardent enthusiasm for the cause of municipal ownership led him to belittle difficulties and distort facts. Beginning with the wild assertion that "the prices of wheat, corn, cotton, and other commodities open to competition are nearly uniform all over the Union, but it does not seem to be so of electric lights,"[1] he proceeds to prove by hook or crook that public lighting invariably costs the people less than lighting by private plants.

Giving no details about time or local conditions, he cites 13 "before and after" cases to show that there was a saving of from one half to five sixths as a result of the change from private to public ownership.[2] He is delighted to find that in 20 cases of municipal ownership, the street lighting was secured for nearly nothing, or even a profit was made, because of the income from the commercial business.[3] He further attempts to prove, by selecting from a table of 42 public and 60 private plants, that lower commercial rates are charged by the former.[4] It is interesting to note, however, that only 7 of the 20 municipalities securing their street lighting so cheaply are included in this list, and that no account is taken of minimum charges, discounts, etc. Yet he is pleased to state that private plants charge "from twice to tenfold" as much as public plants.[5] When he finds that "under private control the labor costs of the Chicago street arcs would have been only $17.50

[1] *Arena*, XIII: 119. [2] *Ibid.*: 381. [3] *Ibid.*: 391–392.
[4] *Ibid.*: 394–395. [5] *Ibid.*: 395.

per year instead of $52.60," thus making the total cost only $61 in place of $96 per arc, he contends that for comparison with private business the lower figure should be used, as the increased expense was due to "politics" and not to the "economics" of the business,[1] though in other places he argues that labor is infinitely better off under public ownership! In another place he contends that Boston would save $800,000 annually by owning her own lighting plant[2] — but enough of this.

In computing the investment per kilowatt capacity, Parsons makes no distinctions between large and small plants, and gives practically no interpretation or information except that the average is much less for public plants.[3] So far as the fixed charges are concerned, he grudgingly admits that municipalities should consider insurance, and taxes lost; but interest, after the bonds are paid, and depreciation, are not properly a part of the cost of lighting. To include interest on the total investment in such cases, when computing the cost of lighting, would be from his point of view merely to take money out of one pocket and put it into the other. The people do not have to pay interest to themselves. Then, too, he considers interest a fundamentally immoral thing. No percentage need be allowed for depreciation because, (*a*) on the average, appreciation will about cancel depreciation, (*b*) little is written off for depreciation by private plants, and (*c*) to make allowance for depreciation each year is really equivalent to giving the capitalist back his capital twice![4]

In view of his strange mental bias it is not safe to accept any of Parsons' "facts" as such. It is hard to believe that four years later Professor Commons would refer with pride to his "extensive investigations" as "the most painstaking and exhaustive statistical analysis of electric lighting yet made from the standpoint of those who favor municipal

[1] *Arena*, XIII: 382.
[2] *Ibid.*: 399.
[3] *Ibid.*, XIV: 88–92.
[4] *Ibid.*: 103–106, 109.

ownership."[1] It is still more startling to find him mentioned twelve years later as "one of the greatest authorities on economics and political science in America,"[2] and about the same time appointed one of the committee to sum up the evidence for the National Civic Federation Report!

It was several years before any further investigations of note were carried on. However, in 1896 Hon. Nathan Matthews, of Boston, in a "Report to the Selectmen of Brookline" regarding a municipal arc-light plant, prepared a table showing the *real* cost of street lights in eleven towns owning their own plants.[3] He also points out some of the errors into which past investigators have fallen. Two years later he published another "Report on the Comparative Cost of Public Lighting," in which he makes a study of the street lighting problem in seven large cities of the country and attempts to draw conclusions with regard to equitable rates in Boston. In his method of attacking difficulties and eliminating differences he has done some useful pioneer work on a small scale, particularly in discussing the municipal plants of Detroit and Chicago.[4] During this year also, the Massachusetts Board of Gas and Electric Light Commissioners for the first time tabulated sufficient data regarding the fourteen municipal plants in the State to enable the student to make a few general comparisons between public and private business.[5] Finally, late in 1897, Professor John R. Commons published an article[6] which was later incorporated in his contribution to "Municipal Monopolies" and which will be discussed in that connection.[7] [8]

[1] *Mun. Monop.*: 68.
[2] *Arena*, XXXVII: 183.
[3] Matthews, *Rept. Brook.*: 10.
[4] Matthews, *Rept. Comp.*: 22–36.
[5] Mass. G. & E., XIII: 56–65.
[6] *Mun. Aff.*, I: 681–673.
[7] In Mass. G. & E., XII: 57, is found a rather remarkable extract from a report submitted by a committee in Springfield on the subject of municipal electric lighting.
[8] For data on private plants at this time the best sources are the *American Electrical Directory*, by E. L. Powers, Chicago, 1898, and Bulletin No. 4112, of the General Electric Company, Schenectady, 1897.

The next serious attempt to study this mooted question on a large scale was made in the well-known book "Municipal Monopolies," first published in 1899. The three articles entitled "Municipal Electric Lighting," "The Latest Electric Light Reports," and "Validity of Electric Light Comparisons," by Professors John R. Commons, Edward W. Bemis, and F. A. C. Perrine respectively, are deserving of some attention,[1] though the last of the three men, a professor of engineering, is the only one who contributed anything new to the discussion.

Commons, setting out to prove that municipal ownership of electric lighting is a highly desirable thing, manfully shoulders his "burden of proof."[2] Then he proceeds to "correct" the estimates of Foster, Francisco, and Parsons as to the cost of lighting in public plants, stating naïvely that all of their estimates, even including those of Parsons, in whose figures he seems to place great confidence, are "above the estimates made by the municipal officials themselves [*sic*], and generally above my own estimates."[3] After a long and tiresome discussion of the stale figures on lamp-hour costs, in the course of which he interpolates a few elementary observations on the "load curve,"[4] he discovers that "rated" candle power of lamps furnishes a very unsatisfactory basis of comparison, and that "quality of light" and "outages" should be given more attention.[5] Having discovered that, in the little public plant of Dunkirk, New York, the street lights are unusually brilliant, and having found that in the one city of Detroit the hours of "outage" were greater under private ownership than under public ownership two years later, he draws the sweeping inference that "such facts as these not only may give us confidence that municipal enterprise does better work than private companies in the field of electric lighting, but they also lead us to look with sus-

[1] *Mun. Monop.*: 55–180; 183–285; 286–296. [2] *Ibid.*: 55.
[3] *Ibid.*: 69. [4] *Ibid.*: 83–85. [5] *Ibid.*: 168–173.

picion upon any statistics favoring private operation which are based upon candle-power cost, even if conscientiously compiled." [1]

In conclusion, he feels reasonably certain that his studies have shown "that the great majority of the three hundred cities and villages now furnishing light are actually getting better service at less cost than those which depend upon private companies." [2] He has little fear of "politics," but does recommend a few reforms as "necessary to accompany or precede municipal ownership"; namely, (*a*) State supervision for cities, (*b*) the substitution of unsalaried commissions for the boards of aldermen, (*c*) the *initiative* and *referendum*, and (*d*) a civil service reform system.[3]

Perhaps Commons' method of disposing of the fixed charges under municipal ownership should be outlined, since his conclusions are so generally accepted by superficial advocates of municipal ownership. Realizing that the real cost of street lighting to towns owning their plants will be high or low in proportion to the fixed charges that are weighed against them, he makes an effort to minimize the importance of taxes, insurance, interest, and depreciation. Interest, he says, should be computed only upon the outstanding indebtedness, not upon the entire cost of the plant, *because* the taxpayers have really contributed nothing, *since* the municipality would be getting its lights for less than would have been paid to a private concern, and *hence* they would have had no alternative use for their money.[4] Regarding taxes, he feels that the loss of income from that source by towns owning their plants "is more than compensated by the increased valuations of property which follow upon increased municipal lighting." [5] Insurance need not be carried by large cities, because a "loss by fire when spread over the tax-rolls would cause but an insignificant increase in taxes." [6]

[1] *Mun. Monop.*: 173. [2] *Ibid.* [3] *Ibid.*: 178–180.
[4] *Ibid.*: 99–102. [5] *Ibid.*: 104. [6] *Ibid.*: 108.

His treatment of the subject of depreciation is a curious mixture of fallacies and contradictions. He inclines to the view that public plants need make no allowance for this item because few private plants do so.[1] As the chief aim of a public plant is to give low prices, no reserve should be accumulated.[2] Depreciation by "use" will be taken care of in the operating expenses, while depreciation by "competitive improvements" and by "replacement" are not a part of the costs of street lighting for a plant which does no commercial business,[3] as the tax levy will easily take care of such charges. A depreciation fund is an absurdity, but a sinking fund is wise because otherwise the public debt "creates an idle class, living on fixed and guaranteed incomes."[4] He seems not to realize that when the bonds are paid off under such a scheme of financing the town might have nothing but a junk-heap on its hands, or in lieu of that a new debt greater than the original one. Throughout, Commons stresses the view that public business is not subject to the same standards as private business and need not be carried on in the same way. How any comparisons of the two classes of business could be made under such conditions, is a mystery.

Bemis gives a complete list of the 353 public plants, 13.5 per cent of the total number in the country, according to his survey, grouped according to States, together with a table showing the age of 143 of them.[5] After studying in a general sort of way the 32 public and 76 private plants in Michigan, and after a hurried analysis of the situation in Massachusetts, he decides that the average commercial rate for public plants is decidedly lower than for private.[6] Then he compares 74 municipal plants with 132 private stations, grouping them according to the number and candle power of their lamps, the hours of use, and the cost of fuel. His conclusion is that, even when 5 per cent interest

[1] *Mun. Monop.*: 109–113. [2] *Ibid.*: 115. [3] *Ibid.*: 115–119.
[4] *Ibid.*: 125–128. [5] *Ibid.*: 188–206. [6] *Ibid.*: 218.

is allowed on the cost of the municipal plants, and 7.5 per cent for depreciation, taxes lost, and other items, the average charge for street lighting in every group of private plants is higher than the cost in the corresponding groups of public plants.[1]

Three very definite criticisms can be made of Professor Bemis's results. In the first place, he uses a simple arithmetical average instead of a weighted average, a fact which makes many of his figures misleading. Furthermore, there is no opportunity to verify the returns upon which his computations are based; we are given only the most meager data, with no local background whatever. But, most significant of all, when a public plant has begun to be operated in connection with a water-works system or some other municipal enterprise, he charges against the street lighting merely the "added" costs, thus letting another department bear most of the lighting burden.[2] In view of this fact, if for no other reason, his figures are practically worthless for comparative purposes, for at that time considerably more than half the municipal plants were "composite," [3] and one of the chief reasons for establishing them was the claim that they could thus be operated at a very low cost.

Professor Perrine points out the futility of all of these investigations which are concerned primarily with comparing the financial cost of lighting under the two forms of management. Such methods do not reach the fundamental considerations; our studies must go beyond the tax rate. Plants without similar load factors cannot be compared. As he has contributed something new to the discussion, it is interesting to note his exact words: —

> The true basis of comparison and the true conclusion in studying the problem of electrical supply is not therefore to be found in the cost to the municipality for a certain portion of that service, but rather in the expenditure of human energy for perform-

[1] *Mun. Monop.*: 240–261. [2] *Ibid.*: 236. [3] Central, 1902: 25–26.

ing the whole service. That electrical plant is of the greatest service to the whole community which supplies a given amount of electrical energy with the smallest amount of plant, the lowest consumption of coal, water, and supplies of every kind, in which the simplest management can be obtained and the smallest number of men employed for the least time in the management, in keeping accounts, in operating machinery, and in performing repairs. So stated, the problem becomes one of the science of engineering, rather than of the science of economics.[1]

In 1900 the much-heralded Fourteenth Annual Report of the United States Commissioner of Labor appeared. A large part of the Report is devoted to an exhaustive compilation of all available data regarding municipal and private electric lighting in the United States,[2] collected mostly in the year 1898 by help of officials of the State Bureaus of Labor Statistics, special agents, and carefully prepared schedules. As returns were secured from only 320 of the 460 known public plants and from only 632 of the 2,572 private plants,[3] the survey cannot be considered very complete. Feeling on the question ran high at the time. Municipal bookkeeping was in a bad state, and private business did not relish being investigated. In the words of the Commissioner: "Private concerns were more able but less willing, and municipal establishments more willing but less able, to furnish the facts required." [4]

For purposes of comparison the plants are grouped according to the horse power of their engines, and not by locality or population. No names of plants or even of States are given. In order to secure a fairer basis of comparison, taxes lost, interest on total investment, depreciation (estimated usually at 5 per cent, excluding land), rentals, insurance, water used, free service, and other items frequently overlooked, but nevertheless forming a

[1] *Mun. Monop.*: 288–289. Cf. *Mun. Aff.*, 1: 605–630, an article in which R. R. Bowker, of the New York Edison Company, points out the fallacies and extremes of most comparisons (see p. 624).

[2] U.S. Labor, XIV: 535–975. [3] *Ibid.*: 12. [4] *Ibid.*: 6.

part of the true costs of municipal plants, are computed. These data, however, are not combined with the usual operating expenses when comparisons of the cost of street lighting are made.[1] The student is left to draw his own conclusions and add whatever items he thinks should be considered.

Some attention is given to various operating expenses, though no very marked conclusions are drawn. No attempt is made definitely to compare the rates for commercial lighting in the two classes, partially on account of the fact that so much of the business was done on a contract basis and the hours of service were not known.[2] But it is distinctly stated that in many cases the reason for a seeming lower cost of *street* lighting in public plants was due to the fact that the prices charged to consumers were sufficiently high to reduce the cost of their own lighting.[3] So far as the comparative cost of street lighting is concerned, the Bureau finds that in practically all cases the cost under municipal ownership is less. But, when the above-mentioned "additional items" clearly entering into the cost are included, the writer finds that the supposed advantages disappear, the municipal plants in general secure their light for no less than do those buying from private concerns, and very frequently pay a good deal more, particularly for incandescent street lighting.

This extensive and impartial investigation marks a distinct advance. Yet the findings are far from satisfactory. The only averages worked out were for salaries and wages, and the prices charged for light. No true averages of costs were found, but only arithmetical averages *of* averages. The kilowatt-hour prices are almost wholly estimates, as there was little metered service at the time. The grouping according to horse power of engines, with no knowledge of load factor or local conditions, is of little service. And,

[1] U.S. Labor, XIV: 17–18, 543–546, 758–764.
[2] *Ibid.*: 19.
[3] *Ibid.*: 548–549.

finally, it is probable that the third of the municipal plants which did not report were, under the circumstances, those whose financial condition was the least satisfactory.

While the National Government had been investigating this question, a number of State Bureaus of Labor and Industrial Statistics were also compiling more or less complete data for their own reports. Of these surveys, the work of the Michigan and New York Bureaus is the most important, though deserving no more than a passing notice.[1] Of various articles upon the subject appearing within the next few years, mention should be made particularly of those published in "Municipal Affairs," among which that by Victor Rosewater, on "The Case for Municipal Electric Lighting," [2] is probably of most significance. He recognizes clearly the difficulties of any accurate statistical comparisons with the data at that time available. Different rate schedules, different length of contracts and franchises, differences in line construction (whether overhead or underground), and the widely diverse rates of depreciation in different localities, would of themselves be sufficient wholly to invalidate such comparisons as were attempted by the Census Bureau.[3]

Owing to the fact that Massachusetts was the only State during this period which prescribed uniform accounting and which kept even approximately accurate records of municipal electric lighting, it seems strange that so little attempt was made to study the subject intensively in this State. The reason for this may be that definite figures would tend to rob the discussion of a goodly share of the interest which is always bestowed upon uncertainties. However, Alton D. Adams, a man of some engineering training, appeared before the United States Industrial

[1] Conn., Labor, XV: 20–41; Kan., Labor, XIII: 91–98; Mich., Labor, XV: 186–188 and 194–197; Neb., Labor, VI: 566–572; N.Y., Labor, XV: 499–565.

[2] *Mun. Aff.*, VI: 622–635. [3] *Ibid.*: 625–627.

Commission in 1900, and presented the brief results of some of his studies of municipal electric lighting in Massachusetts.[1] He selected 17 private plants, in places comparable in size, to contrast with 14 public plants making their current. By adding to the commercial income of the municipal plants the income from all public lighting, estimated at the rates charged for such service by the private plants studied, he finds that after paying for all operating expenses the net income on their investment is 12.3 per cent, while that of the companies is only 10.2 per cent. This he seems to think indicative of greater *operating* efficiency under public ownership. Yet this comparison is sufficiently absurd when we consider that this so-called "net income" may mean much or nothing in proportion as the investment per plant and the corresponding fixed charges are great or small. He admits that he knows nothing about the local conditions;[2] he has no data on the character of the load; he makes no attempt to compare operating ratios; nor does he take into account the taxes lost by municipalities, as well as other items which a study of the returns for that period, 1899, leads us to believe should be charged against many of the municipal plants.

He then endeavors to compute the cost of street lighting to towns owning their plants, by adding to the operating deficit for the year interest on the total investment at the rate paid on the outstanding bonds plus the legal rate of depreciation, 5 per cent, and charging the total to the street lighting account. Making no allowance for taxes lost, he finds that the lamp-hour cost is in some cases higher and in some cases lower than is charged by the companies studied. Though Adams is reluctant to give averages, the writer finds from his figures that for arc lights the cost per lamp hour is almost identical for the two groups, while for incandescents it is slightly higher for the municipal plants. He made no exact computation of the

[1] U.S. Ind. Com., IX: 275–285. [2] *Ibid.*: 280.

commercial charges, but thinks them about the same for the two groups of plants.[1] His studies constitute one more futile attempt to throw light upon a highly complicated problem by a superficial analysis of income and expense accounts.[2]

The Census Report on Central Electric Light and Power Stations for 1902, published in 1905, was the first really comprehensive and systematic collection of material on the subject. Not only were the financial features covered, but also data were given for the physical equipment, output, employees and wages, history, general development, and franchises. Central stations were classified according to their ownership, and grouped by States, and in some instances by population and dynamo capacity. For certain purposes purely electric and composite stations were differentiated. It appeared that, contrary to the general opinion, all but 77 of the municipal plants, considerably less than 10 per cent, were doing a commercial as well as a street-lighting business.[3] While many general comparisons of public and private plants are made, with a view to indicating their relative importance, there is no attempt to draw conclusions. No theories are developed, and frequently the facts are inadequately explained. Much rather necessary detail regarding expenses is omitted. Naturally no load factors are given. The output of current is merely estimated, and not a guess is hazarded as to the amount of current unaccounted for in the various kinds of plants. Furthermore, owing to the lack of anything approaching a uniform system of accounting in central electric stations, much of the material collected is beyond a doubt hopelessly inaccurate. Yet this Report,

[1] U.S. Ind. Com., IX: 282.

[2] Adams has written a number of interesting articles on the subject of municipal electric lighting in Massachusetts. Cf. *Mun. Eng.*, XXIII: 160–164; and particularly *Mun. Eng.*, XXV: 232–240; also references in next chapter.

[3] Central, 1902: 12.

together with the two later ones for 1907 and 1912, furnishes a rich mine of information for the student.

The 1907 Report of the National Civic Federation, on Municipal and Private Operation of Public Utilities, is the most painstaking attempt thus far made to find out whether public industries, judged from every point of view, are really holding their own with private enterprise, both in the United States and in Great Britain. After two full years of work, the Committee of well-known men, constantly assisted by experts, found out — NOTHING. To use their own words:

> The Committee takes no position on the question of the general expediency of either private or public ownership. The question must be solved by each municipality in the light of local conditions. What may be possible in one locality may not be in another.[1]

For the study of municipal electric lighting in this country, two methods were followed. In the first place, four representative public plants were chosen, South Norwalk (Connecticut), Chicago, Detroit, and Allegheny, of which the first alone did a commercial business, and four private plants, Chicago, Pittsburgh, Geneva (New York), and Toledo, which, it was agreed, were operated under approximately similar conditions. Each was studied intensively from many points of view by committees composed of both the friends and foes of municipalization. In addition to the cleverly devised schedules,[2] covering much space and conveying little usable information, many reports of experts were submitted.[3] But, as might have been predicted, no significant conclusions were reached. Our old friends Bemis and Parsons are as enthusiastic on the subject as in the earlier days, though their exuberance is more restrained.

[1] N. C. F., I: 26. [2] *Ibid.*, II: 665–908.

[3] Cf. *ibid.*: 863–884; a carefully worked-out "Report on the Financial Affairs of the Chicago Municipal Electric Lighting Plant," by Marwick Mitchell & Co., in which it appears that the cost per arc in 1894 was $194, somewhat higher than Parsons' estimate (*supra*, p. 18) of $96!

On the other hand, Charles L. Edgar, President of the Boston Edison Company, and Walton Clark, of the celebrated United Gas Improvement Company, of Philadelphia, make out a very strong case for private business. Their conflicting views can best be expressed in their own words: —

> It appears to the writer to be conclusively demonstrated from the above facts that in both water, gas, and electricity the municipal plants have done far better for the taxpayer and consumer than the private plants in anything like a similar situation.[1]

> We believe no intelligent reader of the voluminous record of this Commission's work will fail to conclude that it clearly proves municipal ownership to be productive of many and serious ills, with little or no compensating good.[2]

The second method followed was to select eight public plants to compare with an equal number of similarly situated private plants in Massachusetts. The result of this well-planned investigation consisted of three hundred pages of hopeless junk.[3] Not a single attempt was made to interpret the material laboriously collected by Alton D. Adams and Charles E. Prichard, of the Beverly, Massachusetts, Gas Light Company. And, less strange than it may seem to the casual student, in many instances exactly opposite answers regarding even simple matters of fact, were given by these two men whose views on the subject of public ownership were different. Why the Committee should have devoted all of its attention to the first investigation, which could lead nowhere, and should have completely ignored the second, which alone could have led to definite conclusions, remains a mystery.[4]

Practically the only conclusions to be drawn from this pretentious compilation of the National Civic Federation, so far as our particular subject is concerned, are: (*a*) that

[1] N. C. F., 1: 184; signed by Bemis and Parsons.
[2] *Ibid.*, 441; signed by Edgar and Clark. [3] *Ibid.*, II: 909–1213.
[4] Cf. Central, 1902: 85. One member of the Committee has explained to the writer that both "funds and time" were lacking.

the enormous number of considerations and qualifications which enter into the problem of comparing the two kinds of business make the task of drawing general conclusions well-nigh impossible; (*b*) without the proper interpretation, a great mass of comparable data is in danger of befogging the fundamental issues; and finally, (*c*) no investigation carried on by prejudiced individuals will lead to satisfactory results, for even though the two extremes are averaged, the resulting mean is not necessarily the *truth*.

Since this date interest in the purely financial aspects of the problem of municipal electric lighting seems somewhat to have waned, except for propagandist purposes. More attention has been given to other phases of the question.[1] The general "ignorance and inefficiency" of municipal management has been stressed by many,[2] while others have laid emphasis upon quality and service rather than rates.[3] Some point with glowing pride to what they are pleased to term the "remarkable success" of such public plants as those of Cleveland, Detroit, and Pasadena, while others are astounded at their "colossal failure," and greatly deplore the "crookedness" of their records. South Norwalk has been particularly in the limelight.[4]

Current literature is full of superficial discussions of the subject. For a presentation of both sides of the controversy, one can turn to many numbers of the Annals of the American Academy of Political and Social Science,[5] as well as to the Proceedings and publications of the National Municipal League. For data with which to refute (?) the municipalizers, one need but look through the files of "Concerning Municipal Ownership," and "Public Serv-

[1] *Util. Mag.*, I, 6: 1. [2] Cf. Holmes: 284–287.

[3] Cf. Palmer, in *A. A. A.*, LVII: 33–44; and Larson, in *Jour. Am. Waterworks Assn.*, 2: III: 515–537.

[4] For opposing views on the South Norwalk case see T. C. Martin in Rept. of Com. on Prog., N. E. L. A., 1914: 45–47; and Albert E. Winchester, superintendent of the plant, in *A. A. A.*, LVII: 223–245.

[5] Cf. *A. A. A.*, XXVII, LIII, and LVII, *passim*.

ice." Arguments and facts on the public side can be found in the earlier numbers of the "Arena," in the more recently published "Utilities Magazine," and in the "Municipal Journal." The latter is particularly active in trying to show the economic waste of private ownership, proving conclusively in two pages of a recent number that municipal plants in Massachusetts are superior to the company plants in every way![1] Finally, the more technical publications, the electrical and engineering magazines, generally support the side of private enterprise, on scientific grounds.[2]

There is also a large amount of miscellaneous material upon the subject. Some interesting comparative data have been collected by the special committees of investigation appointed by various municipalities considering the expediency of operating their own lighting systems. Of these mention should be made of the reports of Wellesley, Massachusetts (1900), Binghampton (1905) and Syracuse, New York (1907), South Hadley, Massachusetts (1913), and Geneseo, Illinois (191 ?). A series of eleven pamphlets entitled "Complete Reports on Municipally Owned Utility Plants in the State of Ohio," in which it was attempted to show that practically all of the 78 public electric stations studied are financial failures, was published in 1914–15 by the Public Service Publishing Company of Chicago. The same concern issues a list of municipal plants sold or abandoned, the 1915 edition being entitled "Facts on Municipal Ownership in 268 Towns and Cities." A similar list of "Defunct Municipal Lighting Plants," with a good deal of historical detail, is put out by the Municipal Ownership Publishing Company of New York. Neither list is wholly trustworthy.

[1] *Mun. Jour.*, XL: 266–268; cf. also *ibid.*, XXXIII: 685–696; XXXV: 171–186; and XXXVII: 264–272 and 274–278.

[2] Cf. in particular various numbers of the *Electrical World* and the *Electrical Engineer*.

More dependable in their facts and more scientific in their methods are some of the monographs which have recently appeared. A 1915 bulletin of the Iowa State College of Agriculture and Mechanic Arts, entitled "Electric Central Station Operation in Iowa," presents some interesting studies bearing directly on the subject, in which 10 public stations are contrasted with 46 privately owned.[1] Mr. Harold V. Bozell's "Data on Municipal Plant Operation in Oklahoma" (1916), seems to show that 26 of the larger water and light plants of the State are running behind financially, when all legitimate expenses are charged against them, and that the municipal bookkeeping is in a sorry state.[2] A third brief investigation, very well done, is that of Mr. A. G. Christie, on the "Municipally Operated Electrical Utilities of Western Canada," presented at the Convention of the American Institute of Electrical Engineers in 1916. Nine public plants are carefully studied from many points of view, and some statistical comparisons are made with a group of 19 Massachusetts plants.[3] [4]

Finally, as general aids in investigation, in addition to the quinquennial Reports of the Census Bureau on Central Electric Light and Power Stations, the Annual Reports of the Massachusetts Board of Gas and Electric Light

[1] Iowa, *El. Cent.*: 99–104. [2] Bozell: 7–15. [3] Christie: 308–309, 325.

[4] Just as this book is going to press the writer has discovered one more attempted contribution to the field of municipal electric lighting, in the form of a little book by Carl D. Thompson, entitled *Municipal Electric Light and Power Plants in the United States and Canada*, gotten out under the auspices of the Municipal Ownership League of America.

In this book are collected a number of interesting facts, practically all of which are out of date. The substance of most of the superficial studies already referred to in the present chapter, has been incorporated in Mr. Thompson's book as sound doctrine. There is some detailed account of a few of the more successful publicly owned plants, while others are touched but lightly. It is a frankly propagandist piece of work, and barely skims the surface of the problem. Yet it is referred to by a recent reviewer as "apart from the Census Reports the most complete and exhaustive survey of publicly owned electric generating plants ever made in this country"! (Quoted from Evans Clark in *Util. Mag.*, February, 1918, p. 14.)

Commissioners, of the Wisconsin Railroad Commission (Part III), and of the New York Public Service Commission of the Second District (vol. III), are particularly helpful. For a comparative study of the legal aspects of the problem of municipal electric lighting, the 1913 Report of the National Civic Federation on the "Commission Regulation of Public Utilities," an analysis of the laws of 43 States, is useful. Mention should also be made of "Public Utility Reports Annotated," a bi-monthly publication; "Rate Research," published weekly by the National Electric Light Association; and "Public Service Regulation and Federal Trade Reporter," issued monthly. Much useful financial and physical data on individual plants can be secured from the "McGraw Central Station List," appearing biennially, as well as from the "Public Utility Sections" of Poor's and Moody's "Manuals." The two latter, however, include only private plants.

In conclusion, while it was long ago admitted that inferences drawn from foreign experience in municipalization will not apply in this country,[1] yet in view of the fact that Great Britain has more public than private electric lighting plants (325 *vs.* 269 in 1916), some reference should be made to the best sources for the study of this problem in that country. Among these may be noted the "Returns to the Local Government Board, of Reproductive Undertakings Carried on by Municipal Boroughs," the "Municipal Year Book," Garcke's "Manual of Electrical Undertakings" (an annual publication, of which volumes VII and X contain particularly useful data), and the "Electrical Times Table of Electric Supply Costs and Records."

As municipal plants in Great Britain operate under practically the same conditions as private plants, it should be easier to make comparisons there than here. Yet rather diverse conclusions have been reached by investigators. Of American students of the question, Everett W. Bur-

[1] L. S. Rowe, *Am. Jour. Soc.*, XII: 241–253.

dett[1] and Robert P. Porter[2] have attempted to make out a strong case for the opposition, not merely on the grounds that the tax rate has been increased, as they allege, in spite of the fact that the "profits" made in the business are supposed to help relieve the "rates," but also on the general grounds that the extension of service and development have been retarded by public ownership, and that the political effects are bad. Even Frederic C. Howe, who favors British municipalization, admits that municipal electric lighting has been no startling success in England.[3] Milo R. Maltbie, in the National Civic Federation Report, is decidedly cautious in his conclusions.[4] Among English writers on the subject, the views of Major Darwin and Lord Avebury on the one hand and of Bernard Shaw and Emil Davies on the other, are too well known to need comment. So far as the writer is aware, no champion of public ownership in England has really made a scientific comparative study of the electric-lighting problem, and unfortunately most of the opponents have approached the problem with a prejudiced mind.[5]

NOTE: — For a general study of the problem of municipal ownership, Mr. Douglass Knoop, of England, in his "Principles and Methods of Municipal Trading," has probably done the most scientific work. Incidentally he discusses in an admirable way some of the problems of electric lighting.

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[1] *Jour. Pol. Econ.*, XIV: 313.

[2] Porter: IX–XI, and 261–286, "Strangling the Electrical Industry."

[3] Bureau of Labor, Bull. 62: 58–63. Cf. also Howe, *Brit. City*: 111–118; and, for opposite conclusions, Meyer: chs. XII–XVIII, *passim*.

[4] N. C. F., I: 230–261; and III: 248–382.

[5] It is unnecessary to refer to Germany in this connection. There has been a strong tendency toward municipalization of the electric-lighting industry in that country, and, so far as the writer is informed, the experiment seems to have been attended by reasonable success. Apparent results, however, must be accepted with a good deal of caution, while in attempting comparisons the political system and the national traits of Germany must be fully weighed. (See Dawson: 216, 226–229; and Brooks, in *Q. J. E.*, XXX: 188–194, on "Municipalization of Berlin Electric Works." Also cf. various numbers of the *Kommunales Jahrbuch*.)

CHAPTER II

THE MASSACHUSETTS LAWS AND THE WORK OF THE MASSACHUSETTS BOARD OF GAS AND ELECTRIC LIGHT COMMISSIONERS

From the preceding criticisms it should be sufficiently evident that, aside from the personal prejudices, the unscientific methods, or the superficial interpretations which have in some measure characterized practically all studies of the subject, one of the chief difficulties confronting every student of the problem of municipal electric lighting in the United States has been the hopeless lack of comparable data. Too much guessing has been necessary. As previously suggested, Massachusetts is the only State which for a long period of time has even attempted to keep definite records of both municipal and private electric lighting.[1] Hence the writer has chosen this State for the purpose of his investigation. But before explaining the specific methods of treatment that are to be followed, it will be well to review briefly the main provisions of the Massachusetts laws, in so far as they relate to the problem under consideration.[2] Some mention will also be made of the accomplishments of the Board of Gas and Electric Light Commissioners in their execution and interpretation of the Law.

1. The Massachusetts Laws Relating to the Electric Light and Power Business

The Massachusetts Board of Gas Commissioners, composed of three members, appointed one each year by the

[1] Cf. Central, 1902: 85, and Gray, in *Q. J. E.*, xv: 270–271.

[2] Most references are made to the laws as compiled in 1914 by the Board of Gas and Electric Light Commissioners, "General Laws Relating to the Manufacture and Sale of Gas and Electricity," Chapter 742 of the Acts of 1914, and to the laws as published from year to year in the Reports of the Board.

Governor for a term of three years, was created in 1885.[1] The act provided for a general supervision of the accounts of gas companies,[2] for regulation of the quality and price of gas upon complaint,[3] and for some restriction of competition.[4] The annual expenses of the Commissioners were to be assessed upon the several companies in proportion to their gross earnings.[5] The Attorney-General was empowered to deal with companies violating the law or failing to comply with the orders of the Board.[6] By an act of the next year a system of uniform accounts was prescribed,[7] and the Board was given authority, upon petition, to *compel* the supply of gas under "legal and reasonable" conditions.[8] No bonds were to be issued for less than the par value nor in excess of the paid-up capital.[9] In 1887 the Board was made a "Board of Gas and Electric Light Commissioners," [10] and practically all laws applicable to gas companies were extended so as to include all companies and individuals engaged in the electric-lighting business. It was further made possible for gas companies, upon application to the Board, to engage in the manufacture and sale of electric current for light and power.[11]

In 1888 the town of Danvers constructed an electric plant for the purpose of lighting its streets.[12] The following year the Danvers Gas Light Company petitioned to be allowed to manufacture and sell electric light to the people of the community. Whereupon the town, supported by an almost unanimous vote of the citizens, asked the Legislature to grant them the privilege of doing a commercial

[1] Mass., 1885, ch. 314. [2] *Ibid.*, sect. 7.
[3] *Ibid.*, sect. 9. [4] *Ibid.*, sects. 10, 16.
[5] *Ibid.*, sect. 6. But cf. Mass. 1917, ch. 205, sect. 3, which provides that municipal plants *also* shall share the expenses in proportion to *their own* annual expenses.
[6] *Ibid.*, sect. 12.
[7] Mass., 1886, ch. 346, sects. 1, 2; also Mass. G. & E., III: 126–132; and IV: 176–186.
[8] *Ibid.*, sect. 5. [9] *Ibid.*, sect. 3.
[10] Mass., 1887, ch. 382. [11] *Ibid.*, ch. 385. [12] Mass. G. & E., V: 89.

lighting business. The request was not at this time granted, but finally, in 1891, an act was passed "to legalize the action of the town of Danvers in establishing an electric light plant, and to authorize said town to generate and distribute electric light and power."[1]

The Danvers case was the beginning of a long discussion regarding the propriety of municipalities' engaging in a street and commercial lighting business, which culminated in the passing of the famous "Municipal Ownership Act" of 1891. Among other provisions, cities and towns were given the right to construct their own plants or were required to purchase already existing plants.[2] A uniform system of accounting was prescribed, similar to that imposed upon the companies,[3] and all the general laws relating to the manufacture and sale of electricity were extended to municipalities whenever applicable.[4] Though this act was somewhat modified in 1893,[5] no radical changes in any of the laws have been made since that time. Accordingly it will be sufficient for our purposes to call attention to the main features of the laws regarding electric lighting as they stand at present.

A town or city may "construct, purchase, or lease" an electric plant for the manufacture or distribution of electricity, either for its own use or for the use of its inhabitants (qualified until 1917 by the clause, "except for the operation of electric cars").[6] Nothing in this section of the law, however, prevents a municipality from extending its service to another town which is not already supplied with electric light,[7] though a special act of the Legislature must

[1] Mass., 1891, ch. 378, Special Laws. [2] *Ibid.*, ch. 370, sects. 1, 12–14.
[3] *Ibid.*, ch. 379, sect. 9; also Mass. G. & E., VIII: 263–285.
[4] *Ibid.*, sect. 17. [5] Mass., 1893, ch. 454.
[6] Mass., 1914, ch. 732, sect. 92. This portion of the law was repealed by Mass., 1917, ch. 205, sect. 2.
[7] Cf. Mass., 1915, ch. 191; also the following Special Acts: Mass., 1898, ch. 143; 1901, ch. 97; 1904, ch. 324; 1908, ch. 369; 1910, ch. 581; 1911, ch. 108; 1914, ch. 737; and 1915, ch. 140.

precede such extension, or from selling in bulk to a private company or to another municipal plant. In order to acquire its plant, a *city* must be so authorized by a two thirds vote of each branch of its council, or by a majority vote of whatever sort of governing body it chances to have, passed in each of two successive municipal years, and ratified by a majority of the voters at an annual or special election.[1] A *town* must be authorized by a two thirds majority of the voters at each of two town meetings specially called and "held at intervals of not less than two nor more than thirteen months."[2] If the vote of a *city* is not ratified, no similar vote can be submitted for a period of one year, and if one or both votes of a *town* are unfavorable, no similar vote can be passed within a period of two years thereafter. Also, provision is made for a speedy certification of all votes to the Board.[3] Finally, by a law recently enacted, it is provided that a town or city having once acquired a lighting plant shall not sell the same unless such sale shall have been authorized by votes in the same manner as required for the original acquisition of the plant.[4]

If, when the first vote is passed, there is a private plant already operating in the city or town, and the owners of the same shall elect to sell, the municipality shall be required to buy.[5] Moreover, if a private gas and electric plant in the said place be operated under a single control, the purchase shall include both. If the central station be located outside the city or town, the purchase shall include only those portions of the system within the municipal limits, and the city or town shall be allowed to buy its current from another municipality or from a private plant,[6] or, with certain restrictions, from a street railway company.[7]

[1] Mass., 1914, ch. 742, sects. 95–97. [2] *Ibid.*, sect. 94.

[3] *Ibid.*: sects. 95–97. When "Board" is used, it will be understood to mean "Board of Gas and Electric Light Commissioners."

[4] Mass., 1917, ch. 205, sect. 1.

[5] Mass., 1914, ch. 742, sect. 100. [6] *Ibid.*, sects. 108–111.

[7] *Ibid.* While public plants, as the law originally stood, were not

Furthermore, the municipality may, if it so chooses, purchase additional property of the private plant situated in an adjoining city or town where there is no private lighting plant established, and may thereafter supply current to the said municipality or to the inhabitants thereof, subject to "the same limitations and obligations" as if it were a private business.[1]

The purchase price of such plant as defined by the statute is to be "its fair market value for the purposes of its use, taking into account any depreciation or obsolescence thereof or of any part thereof." But "no portion of such plant shall be estimated at less than its fair market value for any other purpose, including, as an element of value, the damages, if any, caused by the severance of any portion of such plant lying outside such city or town limits, if they [*sic*] are not purchased by the city or town, and excluding any mortgage or other encumbrance or lien to which such plant or any part thereof may be subject at the time of said purchase." Furthermore, "such value shall be estimated without enhancement on account of future earning capacity, or good will, or of exclusive privileges derived from rights in the public streets." And, finally, "no city or town shall be required to buy any property unnecessarily added to a plant after the passage of its first vote, . . . nor any property except such as would be suitable for the ordinary business of the vendor." [2]

If the city or town do not agree with the owner as to the price or the property to be conveyed, it may, within a specified time, apply to the Supreme Judicial Court of the

allowed to sell current to the street railways, for fear of some sinister influence, they have always been permitted to purchase from them at rates approved by the Board.

[1] Mass., 1914, ch. 742, sects. 103, 104, 106.

[2] *Ibid.*, sect. 109. The present earning capacity of the plant was included as an element of value in the original Act of 1891, ch. 370, sect. 12. Two years later this was omitted by section 5 of chapter 454 of the Acts of 1893.

county, which shall refer the application to the Board of Gas and Electric Light Commissioners. The Board, in turn, shall review the entire case, and their decision as to the value or amount of the property to be conveyed, when accepted by the court, shall be final.[1] If any expenses of litigation are incurred under this section, "they may be reckoned as part of the indebtedness for which bonds may be issued" by the municipality.

Subject to a two thirds vote of the voters present in case of a town or a "two thirds vote of all the members of a city council or other governing body," a municipality may contract debt outside the statutory debt limit, but payable within a period of twenty years, for the purpose of "establishing, purchasing, extending or enlarging a gas or electric light plant within its limits."[2] The indebtedness so incurred, however, shall not exceed in towns five per cent and in cities two and one half per cent "of the last preceding assessed valuation." Bonds, notes, or certificates of indebtedness may be issued for the above purposes,[3] but all future bond issues after 1913 are to be on a serial and not a sinking fund basis.[4] Since 1905 it has been unlawful for municipalities to borrow in order to meet any of the annual expenses of their plants.[5][6]

[1] Mass., 1914, ch. 742, sect. 101. Before this date (1914) special commissioners appointed by the court arbitrated the case instead of the Board. Cf. Mass., 1891, ch. 370, sect. 13 and 1905, ch. 401, sect. 1.

[2] Mass., 1913, ch. 719, sects. 6, 12. The statutory debt limit is for a city two and one half per cent of the average valuation of estates for the three preceding years, and for a town three per cent, with a few qualifications.

[3] Mass., 1914, ch. 742, sect. 98.

[4] Mass., 1913, ch. 719, sects. 13–15. Prior to this time both forms of issue were common. Cf. Mass., 1891, ch. 370, sect. 4, in which the issue of 30 years bond bearing not more than 5 per cent interest was stipulated.

[5] Cf. Mass., 1891, ch. 370, sect. 4, 1905, ch. 410, sect. 4, and 1914, ch. 742, sect. 114.

[6] All notes are to be certified by the Director of the Bureau of Statistics. Cf. Mass., 1910, ch. 616, sect. 2.

A *town* undertaking the gas or electric-lighting business *may* elect a municipal light board consisting of three members, chosen one each year for a period of three years.[1] A "manager of municipal lighting," to be appointed by the mayor of a city or the selectmen, or municipal light board, if any, of a town, at a salary and for a term of office to be fixed by those appointing him,[2] and under their "direction and control," shall have "full charge of the operation and management of the plant, the manufacture and distribution of gas or electricity, the purchase of supplies, the employment of agents and servants, the method, time, price, quantity and quality of the supply, the collection of bills, and the keeping of accounts." He shall, before entering upon his office, give satisfactory bond. All money shall be turned over to the town or city treasurer, and all bills shall be paid by the treasurer at the order of the manager. Finally, he shall render to the Board of Gas and Electric Light Commissioners, and to the mayor, selectmen, or municipal light board, if any, such reports as they may from time to time require.[3]

Before the beginning of each fiscal year the manager is required to submit to the mayor, selectmen, or municipal light board, an estimate of the income from sales to private consumers during the following year and of the total expenses of the plant for the same period.[4] The statute defines "expenses" as the "gross expenses of operation, maintenance and repair, the interest on the bonds, notes, or certificates of indebtedness issued to pay for the plant, an amount for depreciation equal to three per cent of the cost of the plant exclusive of land and any water power appurtenant thereto, or such smaller or larger amount as the Board of Gas and Electric Light Commissioners may ap-

[1] Mass., 1914, ch. 742, sect. 112. Cf. also p. 825, *infra*.

[2] The term of office has usually been one year, though re-elections are common. See ch. XIII, *infra*.

[3] Mass., 1914, ch. 742, sect. 113.

[4] *Ibid.*, sect. 114; cf. also Mass., 1913, ch. 692, sect. 1.

prove, the requirements of the sinking fund or debt incurred for the plant, and the loss, if any, in the operation of the plant during the preceding year." The excess of such "expense" over the estimated commercial income, is to be included in the "annual appropriations for maintenance and in the tax levy." The "cost" of the plant, for this purpose, is the "total amount expended on the plant to the beginning of the fiscal year for any purpose for which bonds, notes, or certificates of indebtedness may be issued." "Loss in operation" simply means the difference between the amount received from private customers plus the sum appropriated for maintenance during the preceding year, and the total expenses as above defined.

Depreciation was not included as an item in the annual expenses until 1905, though from 1891 it had been reckoned at five per cent as part of the cost of producing current.[1] In this year an amount equal to five per cent of the *total* cost of the plant, or more or less as the Board might approve, was to be included as part of the expense and to be provided for, if necessary, in the annual appropriations for maintenance or from the tax levy.[2] No part of the sum allowed for depreciation was to be spent for any purpose other than "renewals, in excess of ordinary repairs, extensions, reconstruction, enlargements, and additions." The act further provides that any surplus left, after the above payments are made, "shall be kept as a separate fund and used for renewals, other than ordinary repairs, extensions, reconstruction, enlargements, and additions in succeeding years," and that "no debt shall be incurred for any extension, reconstruction, or enlargements of the plant in excess of the amount needed for the purpose in addition to the amount then on hand in said depreciation fund." The fund is to be kept by the city or town treasurer as a separate fund.

In the following year, after the Board had refused to

[1] Mass., 1891, ch. 370, sect. 10 [2] Mass., 1905, ch. 410, sect. 4.

allow the city of Holyoke to make an allowance for depreciation of less than five per cent,[1] the law was amended so as to make the required depreciation allowance "three per cent of the cost of the plant, *exclusive of land and any water power appurtenant thereto.*"[2]. Finally, in 1908, in addition to the above uses of the fund, it was provided that such portion as the Board may approve "may be used to pay notes, bonds, or scrip issued to pay for the cost of reconstruction or renewals in excess of ordinary repairs."[3] Since this date there has been no change in the law regarding depreciation.

Private plants, it should be noted, have never been required to write off depreciation. This difference in requirements is probably accounted for by the following reasons. In the first place, there has been a general feeling, largely justified by facts, that municipal plants, subjected to constant public pressure for low rates, without regard to the future, and with the tax levy to fall back upon in case of need, should be carefully safeguarded by law in this important matter, even though the rate of depreciation fixed may at times be wholly arbitrary. On the other hand, since the law gives a highly effective regulatory power to the Board, which can thoroughly review the methods of private financing whenever a rate case or a petition for new stock or bond issues comes up, it is supposed that self-interest will restrain the companies from declaring dividends out of capital and so impairing their resources, particularly in view of the fact that it would be practically impossible to capitalize losses incurred in this manner. (See ch. VIII, *infra.*)

When a municipality fixes or changes the price of gas or electricity, which change shall not be oftener than once in three months,[4] and shall take effect on the first day of a month, the manager shall at once notify the Board of

[1] Mass. G. & E., XXI: 45–49.
[2] Mass., 1906, ch. 411.
[3] Mass., 1908, ch. 486.
[4] Mass., 1914, ch. 742, sect. 115.

Gas and Electric Light Commissioners, failing to do which he shall forfeit not more than twenty-five dollars.[1] The price shall not be fixed at less than cost except with the written consent of the Board. In "cost" shall be included "all operating expenses, interest on the investment in the plant, less assessments (for extensions), at the rate paid upon the bonds and serial notes, . . . the requirements of the serial debt or the sinking fund, . . . and also depreciation of the plant to be reckoned at not less than three per cent per annum of its cost, and losses."[2] Above cost as thus computed the municipality shall not be allowed to charge such a price as will yield a profit of more than eight per cent upon its investment, but gas or electricity used by a city or town "shall be charged to it at cost." The enforcement of these provisions rests with the Supreme Judicial Court of the county, which may, upon the petition of the Board or of twenty taxpayers, compel prices to be fixed by the municipality in accordance with the rules laid down.[3]

As to the price charged by the companies, that is subject to the review of the Board. If the mayor of a city or the selectmen of a town, or twenty customers, submit a complaint in writing to the Board regarding the price or quality of gas or electricity sold, the latter shall, after formal notice, give a public hearing to both the petitioners and the company, after which it may order a reduction in price or an improvement in quality, and may fix a *maximum* rate.[4] Such action is subject to future revision by the Board.[5] Differential rates are neither authorized nor prohibited for municipalities or for private companies,[6] while the principle of a minimum monthly charge, though not directly covered by any law, is recognized and endorsed by the Board.[7]

[1] Mass., 1914, ch. 742, sect. 116. [2] *Ibid.*, sect. 115.
[3] *Ibid.*, sect. 125. [4] *Ibid.*, sect. 162. [5] *Ibid.*, sect. 163.
[6] *Ibid.*, sects. 190, 198. Cf. also Mass. G. & E., XXVIII: 27.
[7] Mass. G. & E., XXV: 37–42. The practice began as a meter rental charge.

A municipal plant may require an advance deposit from customers sufficient to pay for three months' use of gas or electricity, and is allowed to shut off the supply when payment is in arrears.[1] Similar provisions apply to the companies.[2] In the matter of *compulsory* supply, however, the law is different in the two cases. No city or town shall be compelled to furnish gas or electricity "except upon the order of the Board."[3] Moreover, a municipality owning its plant is permitted to assess upon "the owner or occupant of any premises" part or all of the cost of "laying and maintaining pipes, conduits, conductors, or other appliances thereon."[4] While payment of such assessments is not compulsory, it is a "condition precedent to the supplying of gas or electricity to the occupants of such premises."[5] A company, on the other hand, upon a written petition from an aggrieved party to the Board, followed by a hearing, can be *compelled* "to supply the petitioner with gas or electricity, upon such terms and conditions as are legal and reasonable."[6]

Both municipal and private plants are required to keep their books and accounts in the form prescribed by the Board,[7] and to hold them, together with all papers, at all times open to the inspection of the Board or of its duly authorized agents.[8] Annual returns in a uniformly prescribed form are to be made to the Board by both groups of plants on or before the second Wednesday in September, for the year ending on June 30th.[9] These returns, practically the same in both cases, are, for companies, to state, among other things, the amount of authorized capital, the indebtedness and financial condition, the dividends paid

[1] Mass., 1914, ch. 742, sect. 115. [2] *Ibid.*, sects. 63, 194.
[3] *Ibid.*, sect. 117. [4] *Ibid.*, sect. 118.
[5] *Ibid.* One of the Commissioners states that there has *never* been a petition for extension under this law.
[6] *Ibid.*, sect. 161. Such petitions and orders have been very frequent.
[7] *Ibid.*, sects. 120, 144, 145.
[8] *Ibid.*, sect. 120, 143. [9] *Ibid.*, sects. 120, 146.

or declared, a list of the salaried officers with their salaries, the income and expenses of the preceding year, and the balance sheet of their accounts.[1] With respect to the records to be kept and the annual returns to be made, no active legal compulsion is exercised over municipal plants.[2] In the case of the companies, however, a very considerable fine is imposed for late returns or for failure to make returns, as well as a heavy penalty for false reports.[3] The law also grants the Board almost equally strict supervision over the books of voluntary associations.[4]

In addition to the foregoing laws a city or town owning its plant is subject to the general laws relating to the "manufacture, use, or distribution of gas or electricity, in so far as they may be applicable,"[5] as well as to the laws peculiarly applicable to public employees, regarding hours of labor, vacations, pensions, etc.[6] Mention should be made, however, of a few additional laws which particularly affect companies and which deal for the most part with questions of franchise, competition and combination, and capitalization.

Practically all electric light and power companies are now organized under the general law of the State,[7] in accordance with which three or more persons may associate for the purpose of forming a gas or electric company.[8] The certificate of organization must be submitted to the Commissioner of Corporations, who, if he finds that the law has been complied with, shall signify his approval by his endorsement thereon and shall file it with the Secretary of State, who, in turn, shall issue a charter[9] which is subject

[1] Mass., 1914, ch. 742, sect. 146.

[2] *Ibid.*, sect. 120. In 1915, 30 per cent of the public plants made late returns, and very few made correct returns.

[3] *Ibid.*, sects. 147, 149. In 1915 about five per cent of the companies made late returns. With few exceptions, their returns needed no corrections.

[4] *Ibid.*, sects. 148, 150–153.

[5] *Ibid.*, sect. 123.

[6] Mass., 1911, ch. 494; 1912, ch. 503; 1914, ch. 217; 1914, ch. 688.

[7] Mass. G. & E., XXIV: ccxcvii.

[8] Mass., 1914, ch. 742, sect. 3.

[9] *Ibid.*, sect. 10.

to amendment, alteration, or repeal by the General Court.[1] Nor can the company begin doing business until all of its capital stock, or such part as may have been approved by the Board of Gas and Electric Light Commissioners, is paid in.[2] And, finally, it is necessary to secure from the mayor and aldermen of a city, or the selectmen of a town, permission to use the public ways for the location of lines and other appliances,[3] which permission they may after notice and a hearing, grant, subject to the conditions which they may see fit to impose. Though there seems to be no specific law on the matter, it is generally understood that franchises are "indeterminate and revocable."[4]

The law seems to encourage both horizontal combinations and integration in the industry. With the approval of the Board, a company may extend its business into an adjoining city or town.[5] Also, after a two thirds vote of the stock, an electric company may, if the Board deem it consistent with the public interest, purchase the property of another company situated in the same or contiguous municipalities, or of a gas and electric company of which the gross receipts from the sale of electricity during the preceding year were at least three times the receipts from the sale of gas, or may consolidate with such company.[6] Additional provision is made for the consolidation of electric and hydro-electric companies, under certain conditions.[7] But the aggregate amount of capital stock and of the debts shall not by such consolidation or purchase be increased.[8] Furthermore, the entry of a second electric company into a city or town is prohibited, except upon the consent of the mayor and aldermen or selectmen, granted after a public hearing.[9] Any party aggrieved by

[1] Mass., 1914, ch. 742, sect. 12. [2] *Ibid.*, sect. 48.
[3] *Ibid.*, sect. 127; 1911, ch. 509, sect. 2; cf. also 1908, ch. 617, sect. 1.
[4] Cf. Mass. G. & E., XXVII: 50, and 321a; Mass., 1914, ch. 741, sect. 124.
[5] Mass., 1914, ch. 742, sect. 61. [6] *Ibid.*, sect. 165.
[7] *Ibid.*, sect. 166. [8] *Ibid.*, sect. 168. [9] *Ibid.*, sect. 156.

such decision may appeal within thirty days to the Board, which, after a hearing, shall render the final decision.[1]

In view of this fostering of monopoly in the electric-lighting business, the State has considered it highly necessary to prevent any form of stock watering. Hence, in addition to the provisions already mentioned, stock dividends are prohibited,[2] and impaired capital is to be made good when such impairment is discovered by the Board.[3] Companies can issue only such amount of stock and bond as the Board may approve as "reasonably necessary" for the purpose for which they are authorized.[4] New shares are to be issued at not less than par, at a price to be fixed by the directors, unless the Board considers such price too low, in which case the latter may determine the price.[5] Nor shall the bonded indebtedness exceed the capital actually paid in.[6] Finally, holding companies are done away with by the law of 1913 which forbids one corporation to hold more than ten per cent of the stock of a gas or electric light, heat, or power company.[7]

2. The Work of the Massachusetts Board of Gas and Electric Light Commissioners

Massachusetts led the other States by about twenty years in commission regulation of private and municipal electric lighting.[8] There were no precedents to follow.[9] Experience and the judgment of the Commissioners themselves have helped to make the law from year to year. The authority lodged in the hands of these three men has been gradually increased, and only once (the Fall River case)

[1] Mass., 1914, ch. 742, sect. 157.
[2] *Ibid.*, sects. 36–37. [3] *Ibid.*, sect. 40. [4] *Ibid.*, sect. 39.
[5] *Ibid.*, sect. 43. [6] *Ibid.*, sect. 38. [7] Mass., 1913, ch. 597.
[8] No other commissions for the regulation of electric lighting companies were created before 1907, and only five before 1910. Since that date about twenty more have been established. Not half of these have jurisdiction over municipal lighting.
[9] Mass. G. & E., 1:6.

has the action of the Board been reviewed or reversed by the superior court.[1] It has constantly been a moulder of public opinion with respect to public utilities, not only in the State, but throughout the Nation.

In dealing with the problem of municipal ownership the Board has, with few exceptions, been untiring in its insistence that public business should conform to the best practice of private business. The task has been enormous. It was many years before any satisfactory accounts could be secured from municipal managers.[2] Constant visiting, advice, and correspondence have been and still are necessary. Much expert assistance is rendered from time to time. In the face of numerous petitions for the lowering of rates, the Board has sometimes abided by the letter of the law, refusing to let current be sold for less than cost as defined by the statute. It has always maintained that taxpayers should not be burdened for the benefit of private consumers. Yet, when there seemed a good prospect of developing business thereby, it has not hesitated to use its discretionary power by granting provisionally a rate lower than cost.[3] At all times the aim has been, not merely to insist upon the principles of sound public finance, but also to inculcate high civic ideals. Whatever may have been the purpose of the framers of the law, and it seems to have been rather hostile to public ownership, the outcome has been that, due to the very restrictions of the law and due still more to the fostering care of the Board, the experiment of municipalization has been carried out under more favorable conditions in Massachusetts than in any other

[1] For an interesting case see Mass. G. & E. XXIX: 12–13, and 386a–395a; cf. Mass., 1915, ch. 21, which extends the supervision of the Board to water companies. Cf. also Mass., 1908, ch. 617; 1914, ch. 742, sects. 1 and 166; 1916, ch. 64, — whereby the authority of the Board has been extended to purely power companies as well as to hydro-electric companies.

[2] Mass. G. & E., XIII: 54.

[3] See Mass. G. & E., X: 33–34; XIV: 10–13; XV: 13, 14; and XXX: 95, 96, 104–108, 110–119.

state in the Union, and, perhaps, than in any other place that we know about, not excepting England or Germany.

As the law for companies has been more complicated and less specific than that for the public plants, the Board has by its decisions and recommendations influenced legislation and established important precedents. If the original purpose of the law was to restrain competition and foster monopoly,[1] it is certainly true that the Commissioners, while abiding by the formal letter, have infused into it the real spirit which should pervade all public utility laws — *strict regulation* for the highest good of all. At an early date the Board called attention to the evils which might result from competition due to failures or future consolidations, as well as to the annoyances which would arise from undue interference with the public highways.[2] The policy has been never to admit a competing company unless it should have been clearly demonstrated that it would in the long run render better and cheaper service than the existing company.[3] Very frequently it has been necessary to reverse permissions granted by municipalities, even after contracts have been entered into.[4] Private individuals have usually been restrained from erecting their wires in the public streets.[5] The Board has always favored one large plant on the ground of efficiency and economy, rather than several small ones,[6] and has by its decisions encouraged the large companies to generate the current for the smaller ones as well as for both private and public consumers in other localities.[7] This policy, combined with con-

[1] Gray, *Q. J. E.*, XV: 254.
[2] Mass. G. & E., V: 3, 4, 93–98.
[3] *Ibid.*, XIII: 11; XIX: 22–25; XXIII: 28.
[4] *Ibid.*, V: 104–108.
[5] *Ibid.*, V: 97, 98, and XXVII: 32–39.
[6] *Ibid.*, XXIV: cccii.
[7] *Ibid.*, XXVII: 316a. A recent order of the Board (1918) is meant to encourage consolidation of resources during the war, with a view particularly to economy in generation of current. This order, with some amplifications, has just been enacted into law by chapter 152 of the General Acts of 1918.

stant regulation of rates, has served to keep those in the business always on the alert.

In public service regulation control of capitalization and rate-making are different aspects of the same problem. When the question of the reasonableness of rates arises, the Board usually reviews the financial history of a company before making its decision. As a result of many years of supervision of stock and bond issues, it considers a physical valuation of the plants in the State unnecessary.[1] In fact, no definite theory of valuation has ever been laid down, but every effort has been made to keep the "fair structural value" of the plant equal to the outstanding stock and bonds.[2] While many years ago it was suggested that a natural increase in the value of real estate might in some cases offset the failure to charge off depreciation,[3] the Board is in general opposed to allowing a return on the unearned increment of land.[4] "Working capital" is rarely mentioned, intangibles are not allowed in the valuation, and the capitalization of high earnings against the public is vigorously opposed.[5] The legal restrictions placed upon the issue of new capital have led to the policy, on the part of the companies, of creating a large proportion of floating indebtedness, most of which at present probably represents lawful expenditures for extensions, improvements, and new plant, but some of which has been occasioned by past losses in operation. This issue of notes undoubtedly complicates the work of the Commissioners, yet they have always stood for the principle that depreciation of all kinds should be paid out of earnings and that losses cannot be capitalized.[6]

[1] Mass. G. & E., XXIX: 374a.
[2] *Ibid.*, XXIV: 43; also Mass., 1896, ch. 473, and 1914, ch. 742, sect. 40.
[3] *Ibid.*, I: 6. [4] *Ibid.*, XXIX: 20.
[5] *Ibid.*, IX: 8, and XXIX: 12, 13, 386a–395a.
[6] *Ibid.*, X: 41–45, and XV: 21–26. On February 21, 1917, the Board, after the Edison Electric Illuminating Company of Boston, failing to secure their approval of a new stock issue, had issued five-year coupon

Though at an early date the Board realized that capital must be encouraged in order to develop the electric light and power business to its greatest efficiency,[1] yet by reason of the comparative regularity of returns which might result from practical monopoly, it maintained that profits could not reasonably be expected to be so high as in more venturesome undertakings.[2] In the Springfield rate case, in 1893, the principle was established that the consumer should pay enough to cover (*a*) the fair cost of production, (*b*) a fair dividend on a reasonable amount of capital, and (*c*) an additional amount sufficient to create a surplus against extraordinary contingencies.[3]

In spite of the large discretionary power left to the Commissioners, it is probably true that no honestly managed company has ever suffered because of the interpretation put upon the terms "fair" and "reasonable."[4] Yet rates have usually been regulated downward, and dividends have in certain cases been temporarily almost wiped out. The *present* has occasionally been compelled to pay for the financial follies of the *past*. The regulation is particularly strict in cases in which there seems to have been exploitation by voluntary associations:[5] "Common control" and interlocking directorates are frowned upon. Special rates are opposed, whether given to a municipality or to a private customer.[6] Differential rates are upheld,

notes to the extent of $10,000,000, petitioned the State Legislature to extend their authority to cover the issue of long-time notes as well as that of stocks and bonds. However, no legislative action was taken on the matter.

[1] Mass. G. & E., III: 56. [2] *Ibid.*, IV: 79. [3] *Ibid.*, IX: 8.

[4] For an interesting comment on this point by "the opposition," cf. Marks: 186.

[5] Mass. G. & E., XXIV: CCXCIX–CCCV; XXV: 15; XXVII: 36a; XXIX: 327–367a; XXX: 49; XXXI: 19–27, 60–63, 96. By an order of December 14, 1916, the Board endeavors to prevent dealings between the companies under their supervision and other concerns with which their directorates interlock. This is a sweeping order which would probably not be upheld in the courts.

[6] *Ibid.*, XVII: 19, 20; XXIV: 48.

not in accordance with any intricate "cost-of-service" principle, but for the practical commercial reason that they are needed at present to get and develop the business, thereby causing an ultimate reduction in price to all consumers.[1] Nor has the Board failed to recognize the fact that the length of contract entered into by a municipality for its street light has a marked bearing upon the price at which that light can be secured.[2]

The Board has expressly avoided suggesting what it considers a "fair" rate of return on the market value of the capital stock.[3] No maximum profit is fixed. In fact it would be highly inconsistent to stipulate a maximum rate of return upon capital that has been acquired under the restrictions and limitations of the Massachusetts laws.[4] High dividends, however, are regarded as a "reward rather than a right," and hence cannot in themselves be an excuse for the maintenance of high prices.[5]

In conclusion, no more fitting statement could be made of the policy which, as an ideal, at any rate, has for thirty years guided the Massachusetts Board of Gas and Electric Light Commissioners, than to quote from a recent address of General Morris Schaff, who for twenty-five years has been a member of the Board. That policy, in a word, is this: —

> Ceaseless and resolute protection of the companies from political demagogues, generous allowance to stockholders upon the legitimate and authorized capital of the undertaking, and, in harmony with a long, deliberate, and oft-repeated policy of the great Commonwealth, insistence upon as low a capitalization as circumstances will permit and such management as will provide for the very best care of the plant, anticipating as far as possible every call for more and better service; and finally, and above all, in season and out of season, the cultivation of honor and a high public spirit on the part of the directorates.[6]

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[1] Mass. G. & E., XXIV: 50–55. But cf. *ibid.*, XIII: 11–14, for an earlier ruling to the contrary.

[2] *Ibid.*, XXIV: 50–55. [3] *Ibid.*, XXX: 40. [4] *Ibid.*, XXXI: 25, 26.

[5] *Ibid.*, XXXI: 31. [6] *Util. Mag.*, I: 3: 137 (January, 1916).

CHAPTER III

MUNICIPAL AND PRIVATE ELECTRIC LIGHTING IN MASSACHUSETTS: METHODS OF COMPARISON TO BE FOLLOWED [1]

1. The Electric Light and Power Industry in Massachusetts

The growth of the electric light and power business in Massachusetts has been comparatively free from the speculation and risks which have characterized the beginning of the industry in many of the newer States. This has been due in large measure to the fact that the State at so early a period began to regulate the companies. Nor does it appear that the industry has been seriously hampered by over-regulation. Both public and private plants have rapidly increased the extent of their service. A study of the accompanying table, however, will show that while there has been a great increase in the investment in private plants during the past twenty-five years, the number actually in operation has tended to decrease. In fact, in 1890 the number of companies of all sorts subject to the control of the Board, many of which were not actually in operation, was fifty per cent greater than in 1915. Though many new companies have been established, many of the older ones have been merged, have changed their management and name, or have ceased operation. The period of most rapid increase was from 1886 to 1890, and during 1889 there were formed 44 new electric companies and

[1] Most of the data in this chapter have been computed from the thirty-one Annual Reports of the Board of Gas and Electric Light Commissioners or from the annual returns made by the individual plants to the Board. Specific references, under the circumstances, will usually not be given, as the presentation is the writer's own.

4 gas and electric companies.[1] Since about 1900 there has been a very considerable decrease in numbers.[2] The number of municipal plants, on the other hand, has continuously grown from only one in 1890 to 39 in 1915, while the periods of greatest absolute increase have been from 1890 to 1895 and from 1910 to 1915.[3]

In 1886 there were 40 electric companies with an aggregate capital of $3,500,000, and average of $90,000 each.[4] Twenty-nine years later 55 solely electric companies reported a total capital of almost $40,000,000, equivalent to

[1] Mass. G. & E., v: 55.

[2] Persons, firms, and private corporations other than electric companies, actually engaged in making or distributing current for light or power, are included whenever the term "plants" or "stations" is used. Unless otherwise indicated, the hydro-electric companies are omitted, as they were not until recently included in the returns, and are relatively new in the field.

[3] In this connection, it may be worth while to indicate the relative importance of the electric light and power business in Massachusetts as compared with that of the other States. From the Census Report of 1912 it appears that the relations are as shown in the accompanying table.

TABLE 3. RELATION OF THE ELECTRICAL INDUSTRY IN MASSACHUSETTS TO THAT IN OTHER STATES

Rank	*For all plants*	*Private plants*	*Municipal plants*
In number	16th	14th	18th
In investment	6th	?	?
In output of current	7th	9th	6th
In generating capacity	5th	5th	6th

It is evident, that, so far as concerns the investment of capital and the actual business done, this State ranks among the first in the industry. The municipal plants, while numerically occupying only a middle position in 1912, stood sixth in point of output of current. Of the five States ranking higher in this regard, only two, Illinois and Michigan, show a noticeable difference, which, by the way, is occasioned mostly by the large publicly owned street lighting plants of Chicago and Detroit. The other three States, Ohio, Wisconsin, and Indiana, rank very close to Massachusetts.

[4] Mass. G. & E., II: 57.

more than $700,000 per company — a sevenfold increase. In 1895 the assets of 83 private plants doing an electric lighting business amounted to more than $18,000,000, or about $220,000 per plant.[1] At the end of twenty years the average (for 77 plants) had increased to almost $1,200,000, which would be subject to a still further increase of $100,000, if the 6 hydro-electric companies, with combined assets of more than $15,000,000, be included. The average assets of 12 municipal plants in 1895 were less than $50,000,[2] while in 1915 we find an increase to $120,000 per plant. Since 1900 the relative increase in the total assets of the two groups of plants has been almost identical — 300 per cent. The proportion which the municipal plant assets bear to the total for all plants, excluding the hydro-electric companies, has stood at approximately 5 per cent during the past fifteen years.

TABLE 4. NUMBER OF CENTRAL ELECTRIC STATIONS OF ALL KINDS IN MASSACHUSETTS (1886–1915)[1]

Central Stations	1886		1890		1895		1900		1905		1910		1915	
	Private	*Municipal*	*Private*	*Municipal*	*Private*	*Municipal*	*Private*	*Municipal*	*Private*	*Municipal*	*Private*	*Municipal*	*Private*	*Municipal*
Under supervision of Board (Jan.):														
Total number	..	..	126	..	88	10	97	17	94	23	97	29	83	39
Electric	..	..	100	..	66	8	73[2]	14	68	17	70	25	61[5]	35
Gas and electric	7	..	26	..	22	2	24	3	26	4	27	4	22	4
Actually in operation (June):														
Total number	42	..	88	1	83	12	97	19	94	23	89	29	80	39
Electric	40	..	65	..	61	10	73[3]	15	68[4]	18	67[6]	25	58	35
Gas and electric	2	..	18	..	20	2	24	3	26	4	22	4	22	4

[1] Persons, firms, and private corporations other than electric companies, actually engaged in making or distributing current for light or power, are included, with the exception of the hydro-electric companies.
[2] Including 14 unincorporated.
[3] Including 11 unincorporated.
[4] Including 12 "others."
[5] Including 9 "others"; 6 hydro-electric companies not included.

[1] The electric assets of 22 gas and electric plants are included.
[2] The gas plant assets are excluded.

TABLE 5. ASSETS OF PRIVATE AND MUNICIPAL ELECTRIC LIGHT PLANTS IN MASSACHUSETTS (1891–1915) [1]

Character of Plant	1891	1895	1900	1905	1910	1915
Private plants:						
Total assets....	$12,114,531	$18,386,096	$23,827,077	$38,640,912	$54,800,639	$91,531,184
Electric	9,931,888	15,620,073	20,648,766	33,520,123	46,963,860	77,568,478
Electric assets of gas companies.	2,182,643	2,766,023	3,178,311	5,120,789	7,836,779	13,962,706
Municipal plants:						
Total assets....	15,000	(?)568,000	1,156,685	2,319,407	3,409,441	4,788,470
Electric	15,000	428,009	970,480	1,435,217	2,296,014	3,372,273
Electric assets of gas plants.....	....	(?)140,000	(?)186,205	(?)884,190	1,113,427	1,416,197

[1] The 6 hydro-electric companies omitted would increase the company assets for 1915 to nearly $107,000,000. The assets given in this table do not always cover the identical number of plants listed in Table 4, due to the fact that one or two unimportant plants may not have returned the proper data.

According to the Annual Report for 1891, 25 out of 57 electric companies in Massachusetts paid an aggregate dividend of $263,000, equal to 4.5 per cent on the entire capital, and ranging from 1 to 10 per cent for the individual companies. In 1915, 43 of 55 electric companies paid dividends of from 1 to 32 per cent, a total of more than $4,000,000, equivalent to about 10 per cent on the capital stock. If, however, we include the premiums realized on the sale of capital stock, as should be done, the rate of dividend becomes only 6.7 per cent. Again, 52 of the companies in 1891 returned an actual net surplus of $475,000, or 9 per cent of the outstanding capital, while in 1915 the aggregate net surplus of 55 companies amounted to more than $5,000,000, or about 13 per cent of the capital. Slight deficits were returned for 12 companies in 1891 and for 5 in 1915. For the municipal plants there was a total deficit of $86,000 in 1897, and an aggregate surplus of $800,000 in 1915, of which $750,000 was the reported surplus of the Holyoke plant.[1]

It is impossible to secure any accurate data regarding

[1] If the surplus is properly apportioned between the gas and the electric plant, the total becomes very much smaller.

the total output and sales until about 1907 or 1908, as much of the current was not metered before that time.[1] It appears, however, that 12 of the 52 plants operating in 1887 were selling some current for power and all but 3 report a commercial lighting business.[2] Ten years later, though all of the municipal plants but 2, Needham and Wellesley, did a commercial lighting business,[3] practically no power was furnished by them. Since 1906, however, all public plants do private lighting, and during the past ten years, the power business of the municipal plants has gradually increased until at present the relative amount of current sold for this purpose is about the same for the public as for the private plants. Of the 85 private plants which operated at some time during the year 1915, 11 report no power sales, while 3 and probably 5 of the public plants sold no current for power.[4]

According to the Census Report on Central Electric Light and Power Stations for 1902,[5] the estimated yearly output of 97 private stations in Massachusetts was 121,600,000 kilowatt hours, or 1,250,000 per plant. For 17 public stations the total output was 4,200,000 kilowatt hours,[6] approximately 250,000 per plant. In 1915, 75 private plants show an average output of more than 6,700,000 kilowatt hours each, which decreases to about 4,000,000 if we omit the Boston Edison with an output of nearly 200,000,000 during the year. If, however, *all* concerns doing an electric light and power business are counted,[7] including five hydro-electric companies,[8] it ap-

[1] Mass., 1905, ch. 410, sect. 5. The Board is empowered to require municipalities to meter their current.

[2] Mass. G. & E., III: 59–67.

[3] Three others, Braintree, Danvers, and Peabody, began doing only street lighting, but soon added the commercial business.

[4] The returns are made out in such a way as to leave the matter doubtful in two cases.

[5] *Op. cit.*, 123. [6] *Ibid.*, 139.

[7] Five small plants did not report the output for the year.

[8] The output of one of the large hydro-electric companies is not given

pears that 85 stations had an average output of nearly 8,000,000 kilowatt hours. The 39 municipal plants during the same year had an average output of about 1,000,000 hours; but as Holyoke alone produced more than one third of the total, it should be omitted in computing the average, which then becomes 650,000. While the output per plant has not increased so rapidly in the public as in the private stations, the *relative* total output has until recently increased much more rapidly. Whereas in 1902 the municipal output seems to have been about 3.3 per cent of the total, it amounted in 1907 to 6.0 per cent, and in 1912 to 7.2 per cent. For 1915 the proportion stands at 7.0 per cent, or at only 5.4 per cent if the hydro-electric companies are included. The rapid increase during the first five-year period was occasioned by the accession of Holyoke, and since 1912 there has been a noticeable falling-off.[1]

The accompanying table (Table 6), though for the earlier periods based partially on estimates, will serve in a rough way to indicate the relation which the unit operating costs and income bear to each other in the two groups of plants.

As the current used at stations, unaccounted for, and lost through lines, transformers and meters, could not be determined for 1902 and 1907, only the total output and not the amount actually sold has been used in making the computations throughout. For the municipal plants the estimated value of free service (public lighting) is included for every year except 1915; but for this year the actual commercial income is used and the amount of current put out for street lighting is deducted from the total output in making the computation. This will account partially for the seemingly low income figure given for

as it does no transmission business. One hydro-electric company reports an output of 125,000,000 kilowatt hours for the year ending June 30, 1915.

[1] See Table 6.

TABLE 6. OPERATING EXPENSES AND OPERATING INCOME PER KILOWATT HOUR OUTPUT IN PUBLIC AND PRIVATE PLANTS (1902–1915) [1]

Date	*Operating expenses per kilowatt hour output (cents)*		*Income from sale of current per kilowatt hour output (cents)*	
	Companies	*Municipal*	*Companies*	*Municipal*
1902	3.38	5.21	5.41	6.31
1907	2.77	3.26	4.72	5.69
1912	2.22	2.77	3.76	4.53
1915	2.12	2.44 (3.03)[2]	3.46	3.61 (4.40)[2]

[1] The data on which this table is based are derived from the Census Reports for 1902, 1907, and 1912, from the Annual Reports of the Board for the same dates and for 1915, and from a study of the municipal returns for 1915.
[2] Excluding Holyoke.

1915, which would have been 4.40 cents had the public plant of Holyoke been omitted, since it is too large to be typical of this group of plants. It must also be explained that the decided decrease in the unit cost of municipal plants from 1902 to 1907 is in large measure due to the fact that the Holyoke plant was taken over during that period.[1] Furthermore, we must remember that only by making allowance for the difference between *output* and *sales*, varying from plant to plant and in many cases amounting to 25 per cent of the total, can any fair basis of comparison be established. The nature of the business done, the character of the territory served, the age and size of the plants, the kind of primary power used, and many other factors, must all be considered if we wish to be accurate. Finally, in the case of the public plants the "operating expenses," as returned and as used in the computation, by no means represent the *real* costs. Of this more will be said later. The figures serve to show,

[1] Holyoke began operation as a municipal plant at the end of 1902, and made no return until 1903.

however, that both municipal and private plants have been steadily reducing their operating expenses as well as their charges for current.

The integration and horizontal combination previously referred to have been very marked in the electric lighting and power business in Massachusetts, particularly since 1900. In 1887 there were 52 plants actually in operation, supplying current to 60 different towns and cities,[1] and in 1900, 97 plants supplied 124 municipalities. But 80 private plants reporting in 1915 did business in 248 different municipalities, of which the Boston Edison alone supplied 39.[2] The 39 public plants at the same date furnished current to only 43 cities and towns. There have also been a large number of combinations of gas and electric companies, while many gas companies have undertaken the supply of electricity, thus effecting certain economies, particularly in management. The proportion of such composite plants has remained nearly constant for more than twenty years and amounted to about 28 per cent of the total in 1915. Finally, at least 30 per cent of all the private plants are owned or controlled by six voluntary associations, and several well-known groups of investors control a large portion of the rest. This aspect of the question, however, is scarcely relevant to the subject under discussion.[3]

Of great significance is the fact that while in 1887 the 52 plants mentioned all generated their own current,[4] twenty years later 17 of the 69 private plants reported, or 25 per cent of the total, produced no current,[5] and in 1915 out of 80 plants 32, or 40 per cent, were buying all of their

[1] Cf. Mass. G. & E., III: 59–67, and XXVII: 316a.

[2] *Ibid.*, XXXI: 156–159.

[3] For interesting discussions of consolidation and common control, see Mass. G. & E., XXIV: ccxciv–cccvii, and XXIX: 327a–367a. Cf. also Mass. G. & E., XXXI: 12–13.

[4] Cf. Mass. G. & E., XXVII: 316a.

[5] *Ibid.*, XXIV: ccxcix.

current. At the latter date at least half as many more were purchasing *some* current, in several cases more than 50 per cent of their output. This change has been due largely to the fact that many of the smaller concerns formerly generating their own current have found it more profitable to buy from the larger companies, and partially to the fact that within recent years a number of plants have commenced operation with only a distributing system. Of the municipal plants about 20 per cent produced no current during the period 1895–1906, while at the beginning of 1916 the proportion had increased to 60 per cent of the total, 23 out of 39 plants, and two others were buying the greater part of their current.[1] By the end of 1917, however, only 11 of these plants were generating current. Thus it appears that 50 per cent of the electric plants in the State are now buying all of their current.

The accompanying table (Table 7) has been arranged for the purpose of showing the relative amounts of current purchased by public and private plants in 1907 and 1915. Re-sales have been deducted whenever they could be ascertained.[2]

In 1907 the companies bought 3.6 per cent of their total output, while in 1915 the amount had increased to approximately 10 per cent, either excluding or including the hydro-electric companies which also purchase a considerable quantity of current. The proportion purchased by municipal plants has also increased at an equal rate from 6.6 per cent to 18.4 per cent. Upon analysis it appears that the private plants in 1915 purchased a total of 50,000,000 kilowatt hours, of which more than 12,000,000 were

[1] Wakefield ceased generating current during the fiscal year 1914–15, and Hull, at the end of 1915, voted to purchase her current in the future. During the next two years five other plants followed suit.

[2] Only round numbers are given, and, in places, estimates had to be used. The computations are based on data which can be found in very unsatisfactory shape in the following sources; Central, 1907: 153, 165; Mass. G. & E., XXIII: 167, and XXXI: 332a–336a, 360a.

TABLE 7. NUMBER OF KILOWATT HOURS GENERATED AND PURCHASED (1907 AND 1915)

Kilowatt hours output	*1907*		*1915*	
	Companies	*Municipal*	*Companies*	*Municipal*
Generated....	198,500,000	12,200,000	596,000,000 (457,000,000)[1]	31,000,000
Purchased....	7,500,000	800,000	66,000,000 (50,000,000)[1]	7,000,000
Total..	206,000,000	13,000,000	662,000,000 (507,000,000)[1]	38,000,000

[1] Hydro-electric companies excluded.

secured from each other, about 8,000,000 from various manufacturing concerns and street railways, and 30,000,000 from the hydro-electric companies. If the hydro-electric companies are included, the total becomes about 66,000,000, and it is found that in addition to the above purchases the latter bought more than 10,000,000 kilowatt hours from the electric companies and 6,000,000 from each other. Of the 7,000,000 hours purchased by municipal plants, 340,000 were secured from each other, 1,350,000 from hydro-electric companies, and 5,300,000 from various electric companies. If we compare the data here given with the number of plants which generate no current, it is obvious that for the most part only the smaller plants are buying their current.

A study of Table 8 will disclose the fact that 22 per cent of all private plants serve a population under 3,000, 15 per cent a population between 5,000 and 10,000, and 56 per cent a population greater than 10,000. On the other hand, 44 per cent of the municipal plants serve districts with less than 3,000 inhabitants, 33 per cent a population ranging from 5,000 to 10,000, and only 21 per cent a population greater than 10,000. Absolutely, the largest

Table 8. Number of Plants serving a Given Population (1916)

Character of plant	*Under 1,000*	*1,000 to 3,000*	*3,000 to 5,000*	*5,000 to 10,000*	*10,000 to 20,000*	*20,000 to 50,000*	*50,000 to 100,000*	*Over 100,000*	*Totals*
I. Companies									
Generating	1	4	2	3	10	15	0	11	46
Buying Current	0	12	3	9	5	3	0	0	32
Total	1	16	5	12	15	18	0	11	78[1]
II. Municipal									
Generating	0	1[2]	0	9	3	2	1	0	16
Buying current	3	13	1	4	2	0	0	0	23
Total	3	14	1	13	5	2	1	0	39
Grand total	4	30	6	25	20	20	1	11	117

[1] 2 small plants in Boston not included.

[2] In 1916. In 1915 there were 2.

number of central stations is found in the population groups under 3,000 and between 20,000 and 50,000 for the companies, and in the groups under 3,000 and between 5,000 and 10,000 for the municipalities. Of the private plants generating their current, 80 per cent serve population groups in excess of 10,000, while less than 40 per cent of the public plants serve such groups. Private generating plants are found to be most numerous in the population group between 20,000 and 50,000, amounting to 33 per cent of the total. The largest number of public generating stations, 56 per cent of the total, is met with in the 5,000 to 10,000 group. There is a similar inverse correspondence in the case of plants buying all of their current. Of the companies 38 per cent serve population groups under 3,000, and 53 per cent serve groups of more than 5,000. But 70 per cent of the municipal distributing plants are found in places with less than 3,000 inhabitants, and only 26 per cent serve groups larger than 5,000. The highest absolute numbers in each case are found in the population groups under 3,000 and between 5,000 and 10,000. Finally, it is interesting to note that, early in 1916, 10 of the private as well as 10 of the public generating stations served districts with less than 10,000 population, and that 24 private and 21 public distributing plants (75 and 90 per cent of the respective totals) are found in the same groups. This fact would suggest the possibility of making some useful comparisons between municipal plants and the smaller companies, if other conditions are found to be approximately equal, though there is not necessarily any quantitative relation between the population of the district served and the output of a central station.

From these preliminary surveys it is evident that the public plants, situated for the most part in the smaller municipalities, constitute more than 30 per cent of the total number of central stations in Massachusetts, represent about 5 per cent of the total assets, and put out about 7

per cent of the current (4.3 per cent of the assets and 5.4 per cent of the output, if the hydro-electric companies be included). Though the casual student might be induced by these figures to draw the conclusion that the public plants are doing a proportionately greater business with a smaller capital outlay than the private concerns, the data are, for numerous reasons, scarcely comparable except in the most general sort of way.

In the first place, the Holyoke plant alone accounts for one fourth of the assets and more than one third of the output of current for the municipal plants. This fact tends to make any general averages practically worthless, for what is true of Holyoke is by no means true of the remaining plants. Its effect upon the averages is too great. Similarly it may be argued that the Boston Edison, with 50 per cent of the assets of all private plants (hydro-electric companies excluded) and producing two fifths of the current supplied, distorts the averages for the other group.

Again, many of the private plants, having ceased either wholly or in part to generate current, are burdened with a large investment in useless generating equipment — dead assets. This was true of only two or three of the municipal plants, at the time under consideration. Furthermore, many of the public plants, particularly those buying current, carry no account for real estate which has been taken over from the municipality or which is owned by another "department," and when they do carry this account it is usually placed low. Also they have very frequently exercised their franchise right of attaching their lines to foreign poles, whereas the companies generally own their own poles. All of these facts would naturally tend to make the plant accounts of municipal stations relatively less than the company accounts.

Practically no underground construction has been installed by the public plants, whereas, even in 1911, 50 per cent of the value of the distributing systems of the private

plants was accounted for by the underground lines and conduits.[1] At the same time 40 per cent of the total investment of the companies was in their distributing systems. Hence, as there has been a rapid growth of underground construction during the past few years, a conservative estimate would put the aggregate value of the underground systems at about 25 per cent of the total investment. And, since this item, in the majority of cases, probably represents by so much an absolute addition to the investment, due to the cost of changing from the old overhead system, this alone would be almost sufficient to reverse the relation which above appeared to exist between the proportionate assets of the municipal plants and their proportionate output of current.

Finally, the plant accounts as carried by the municipalities have been constantly written off each year for depreciation, at the rate of 5 per cent until 1907, and at the rate of 3 per cent in most cases since that date. The policy of the private plants has been very irregular in this regard. Accordingly their plant accounts, when compared with those of the public plants, will appear unduly large.

This is a mere suggestion of some of the more obvious conditions and considerations which totally invalidate the conclusions of one who attempts to make comparisons of this kind *en masse*. Other plausible comparisons would be subject to similar criticisms. A more careful study of the countless determining factors is demanded, and in the end our conclusions, if really scientific, will doubtless be relative rather than absolute. Hence, with this general outline of conditions to serve as a crude sort of guide to our future study, no further attempt will be made to establish any general comparisons between municipal and private electric lighting. A point has at last been reached where we can get our bearings, and attempt to apply those methods of investigation which may prove most fruitful.

[1] Mass. G. & E., XXVII: 326a.

Before this task is begun, however, a brief additional reference must be made to the history of municipal electric lighting in the State.

At an earlier date opinions were divided as to the effect which the Massachusetts laws have had upon the growth of municipal electric lighting. Some ardent champions of public ownership at any price have contended that the provision in the law making it possible for an already existing plant to force the sale of its property, both gas and electric, upon a municipality wishing to begin business for itself, is decidedly unreasonable, and that it should at least be permissible for a city or town to install its own street lighting system without such a restriction. Others have maintained that public ownership has been directly fostered.[1] The truth of the matter seems to be that many municipalities have been deterred from taking the decisive step because of the caution and deliberate action which the law induces. It is equally true that when public plants *have* been started, they have, for the most part, been enabled to make a fair success of the undertaking, by reason of the restrictions imposed by the law, the aid rendered by the Board, and the active interest taken by the community.

Of the 39 publicly owned plants in the State, 16, or 41 per cent, have been transferred from private ownership. Half of this number were generating plants, 4 of which did solely an electric business [2] and 4 a combined gas and electric business.[3] The remaining 8 plants never generated current, and in three cases a local plant was taken over,[4] while in five cases only the distributing system of an out-

[1] For some expressions of opinion on either side of the question, cf. Matthews, *Rept. Brook.*: 16, 27–29; Adams, in *Pol. Sc. Quart.*, XVII: 247–255; Central, 1902: 84; and Parsons, Commons, and Bemis, in *op. cit.*

[2] Hull (1894), Chicopee (1896), Hudson (1897), and Taunton (1897).

[3] Middleborough (1893), Wakefield (1894), Westfield (1899), and Holyoke (1902).

[4] Ashburnham (1908), Middleton (1913), South Hadley (1914).

side company was bought.[1] Seven of the generating plants were bought before 1900 and the other one shortly afterward. Only two of the distributing plants were acquired during this time.

TABLE 9. PRIVATE PLANTS CHANGING TO MUNICIPAL OWNERSHIP

Character of plant	*Before 1895*	*1896 to 1900*	*1901 to 1905*	*1906 to 1910*	*1911 to 1915*	*Total*
Generating plants.....	3	4	1	0	0	8
Distributing systems (or plants).....	1	1	0	3	3	8
Total.....	4	5	1	3	3	16

In every instance in which a municipality has decided to do its own lighting, the local company, if there was one, has expressed its willingness to sell, and in accordance with the law the sale has been made, with the single exception of North Attleborough, which disregarded the law, built its own plant, and forced the existing company to move elsewhere.[2] These transactions, however, were usually accompanied by a good deal of litigation. An amicable agreement as to the price of the property to be conveyed was made in but seven cases — all very small plants and only two with a generating system.[3] In the nine remaining cases, six of which were generating plants, the courts and specially appointed commissioners had to decide upon the terms of transfer.[4]

As might have been expected, the owners fought for a higher price than the municipalities wished to pay, while

[1] Hingham (1895), Belmont (1898), Wellesley (commercial lighting system, 1906), Groveland (1907), and Lunenburg (1914).

[2] Mass. G. & E., IX: 50; Adams, *Pol. Sc. Quart.*, XVII: 249.

[3] Middleborough, Hull, Hingham, Wellesley, Ashburnham, Middleton, Lunenburg.

[4] Chicopee, Wakefield, Westfield, Hudson, Taunton, Holyoke, Belmont, Groveland, South Hadley.

the latter stood out frequently for a ridiculously low figure. Though the awards seem to have been perfectly fair to both parties, since no intangibles could legally be included in the valuation, yet it has frequently been asserted that in most of the ten instances of purchase before 1902 the municipalities paid too much for their plants, as shown by higher fixed charges, higher commercial lighting rates, and a higher cost of street lighting than in the other plants.[1]

It is probably true that the municipalities building their own generating plants had an advantage over those compelled to buy, as they could utilize all the latest developments in the industry and could profit by the lower cost of equipment. None of these (10 in all) were equipped for both commercial and street lighting until after 1893, and 4 of them after 1900.[2] Of the generating plants acquired from private owners, on the other hand, 7 out of 8 began operation before 1889,[3] at a time when the electric business was in a highly experimental stage. Countless mistakes and miscalculations were constantly being made, patent rights and machinery were secured at exorbitant prices, and depreciation from obsolescence and from inadequacy was exceedingly rapid. The business was not seasoned, early losses were great, and dividends were very uncertain.

[1] Cf. Adams: *Mun. Eng.*, XXV: 232–240; also *Mun. Monop.*: 154–155, 223–228, where an attempt is made to prove that in spite of these handicaps municipal rates were lower than private rates. For a discussion of the bitterly contested Holyoke case see Adams in *Q. J. E.*, XVII: 648–668, and vol. XVI of the Holyoke Case (Nathan Matthews' Brief). Adams maintained that Holyoke paid about twice as much as the plant was worth, while Mr. Matthews has informed the writer that beyond a doubt the city secured its plant at *half price!* So much for expert opinions on valuation. The later history of the plant indicates that the city made no bad bargain, considering the nature of the territory.

[2] Danvers (street lighting, 1889, commercial lighting, 1896), Braintree (streets, 1892, commercial, 1894), Peabody (street, 1892, commercial, 1893), North Attleborough (1894), Marblehead, and Reading (1895), Concord (1900), Ipswich (1908), Merrimac and Mansfield (1904).

[3] Taunton (1882), Hudson (1886), Chicopee and Westfield (1887), Wakefield and Holyoke (1888), Middleborough (1889), Hull (1893).

Hence, even disregarding the intangible items, it is easy enough to see that, in order to recoup the owners for their *bona fide* investment, municipalities were in some instances obliged to pay more for their old plants than would have been sufficient to construct new ones of a better type, and frequently a part of the equipment was rapidly junked. However, the question is largely one of speculative interest. Municipalities, even though they may in one or two cases have acquired antiquated plants, have not fared half so badly in this regard as have practically all the companies.

Early in 1915 some kind of action on the question of municipal ownership had been taken by 105 cities and towns, or 30 per cent of all municipalities in the common-

TABLE 10. ACTION TAKEN BY MASSACHUSETTS CITIES AND TOWNS REGARDING MUNICIPAL OWNERSHIP OF ELECTRIC LIGHTING (1895–1915) [1]

Classification	*Before 1896*	*1896 to 1900*	*1901 to 1905*	*1906 to 1910*	*1911 to 1915*	*Totals*
1. Municipalities taking action	45	18	9	20	13	105
2. Municipalities beginning operation	12	6	5	7	11	41 (39)[2]
Ratio of 2 to 1 (per cent).	26.7	33.3	55.5	35.0	84.6	39.0 (37.1)[2]

[1] It is not always the case that a municipality taking action at a certain time has begun to operate its plant during the same period. The table, however, shows what has actually taken place.
[2] Actually in operation in 1915.

wealth. Of this number, 77 had brought the matter to a vote, — 69 in popular elections and 8 in the city councils, — 26 had simply appointed investigating committees, and 2, Danvers and Miller's Falls, had acquired their plants under special acts of the Legislature. Nearly 60 per cent of the municipalities which have submitted the matter to a popular vote have adopted public ownership, while nearly 40 per cent of all those which have taken any action

whatever, or 11 per cent of the 353 towns and cities in the State, are at present operating their plants.

It appears from Table 10 that a good deal of enthusiasm on the subject of municipal ownership was aroused before 1895. This was probably due largely to ignorance of the real issues involved, as well as to a desire to make use of the privilege newly created by law with a view to securing lower rates. That so little, comparatively, was accomplished, can doubtless be explained by the fact that almost no current was sold by one station to another at that date. Hence, a municipality was confronted by the proposition of building or buying its entire generating and distributing plant at a high cost. As time has gone on, however, the agitation has become less and the *effective* action relatively greater, until in the latest period practically every town considering the question has acquired a plant. Upon comparing this table with the others it is evident that the comparative ease and inexpensiveness of installing a distributing system in small towns whose business is not particularly desired by the companies, and the possibility of buying cheap current from large central stations, have acted as a stimulus to this "small scale" public industry.

The accompanying table presents this phase of the development clearly.

TABLE 11. MUNICIPAL PLANTS BEGINNING OPERATION AT CERTAIN DATES

Character	*Before 1890*	*1891 to 1895*	*1896 to 1900*	*1901 to 1905*	*1906 to 1910*	*1911 to 1915*	*Totals*
Plants generating current.....	1	8	5	4	0	0	18
Plants buying current.....	0	3	1	1	7[1]	11[1]	23
Total.....	1	11	6	5	7	11	41

[1] One ceased operation at each of these dates. Hence 2 should be deducted to show the net increase.

Since 1904 not a single generating plant has been purchased or built. Two plants formerly producing their current, Wakefield and Hull, have within the last year or two ceased to do so and are doing only a distributing business. Two others, Chicopee and North Attleborough, will doubtless soon follow the same policy.[1] Only two municipal plants have become defunct,[2] Needham, which did a street lighting business from 1893 to 1908, and Miller's Falls, which operated from 1903 to 1912. Both bought their current, and both sold their distributing system to private companies when they ceased operation. Since 1907, 18 distributing plants have been launched, almost 50 per cent of the total number of public plants, and 11 of these are accounted for in the three-year period 1911–1914. This fact would seem to indicate that the smaller towns expect a very considerable saving as a result of municipal ownership. Though it is perhaps too early to say whether this expectation will be realized, the question will later be fully discussed.

2. Methods of Comparison to be followed

The relative status of municipal electric lighting in the State has been sufficiently indicated. If the student of this problem wishes to draw any definite or even reasonable conclusions, he must conduct his investigation in an orderly, specific manner. Things fairly comparable must be compared. If the survey be too extensive, many of the vital issues will tend to be obscured by a mass of complicated and conflicting data. On the other hand, if the study

[1] Within a few months after the above was written, not only these plants but three others as well had stopped the generation of current (Mansfield, Merrimac, and Middleborough).

[2] After this had been written the writer discovered that the town of West Springfield owned a distributing system for about sixteen years. Becoming greatly dissatisfied, however, it sold its lines to the United Electric Company of Springfield, in 1914. No returns were ever made to the Board, which seemed to be unaware of its existence.

be narrowed to a comparison of only one or two public plants with the same number of private ones, while the work would be greatly simplified, the conclusions reached would have to be revised for every new case which might arise. A sufficient number of observations must be made to enable the investigator to establish some norm and to eliminate the extremes.

The object of the present study is to determine as nearly as may be the results of municipal electric lighting in Massachusetts, viewed not merely from one or two angles, but from all angles. No absolute standard of measurement can be set. Though balance sheets, operating accounts, and rates have been usually zealously invoked in researches on this subject, they *alone* can indicate but a limited portion of the real issues involved, for they are *relative* rather than *fundamental* considerations. They are the results of other factors not so easily discoverable, but in many cases far more significant.

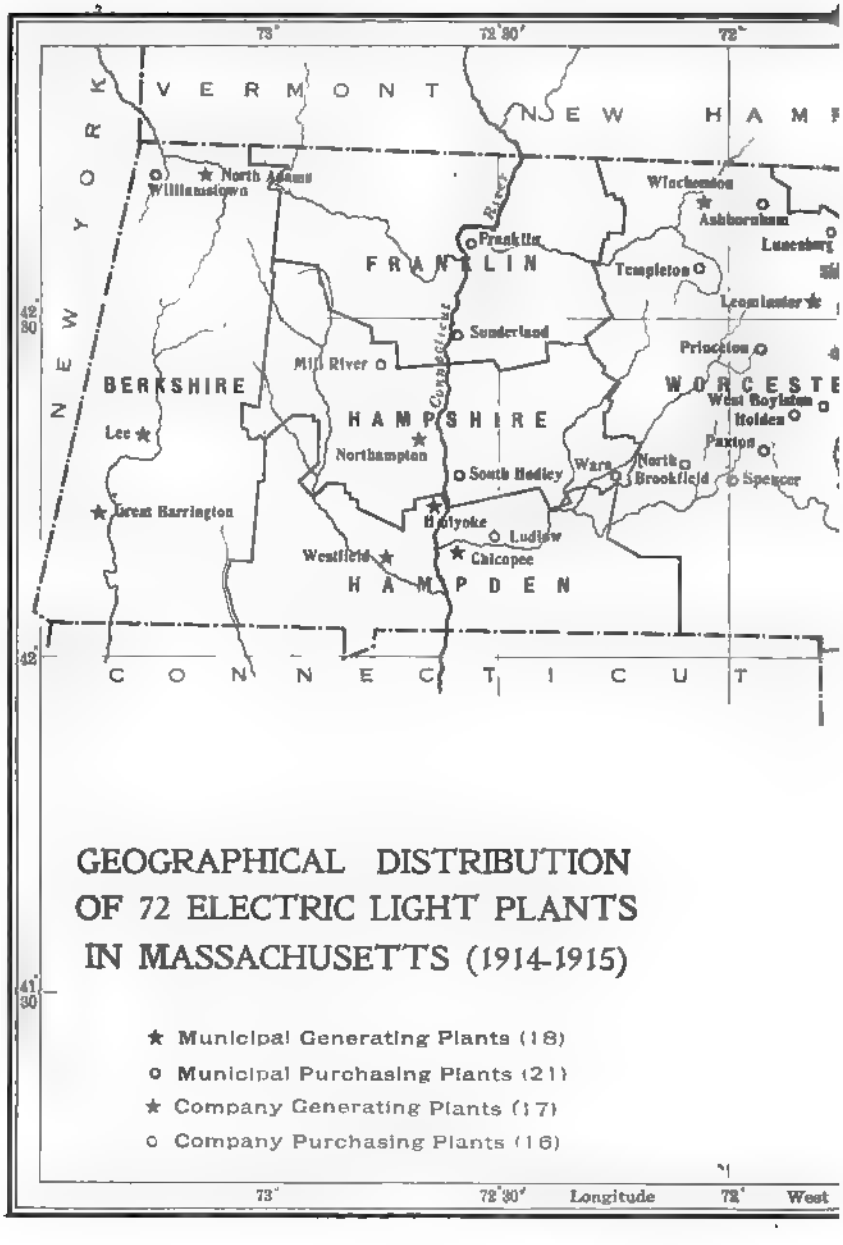
The question is still further complicated by the fact that public and private business are being carried on side by side, with the latter greatly predominating. The tests which, in themselves, it might seem reasonable to apply to publicly owned plants, might prove, on the one hand, hopelessly inadequate, or, on the other hand, highly unfair, if we endeavor to apply them to private business. Hence, in order to direct our investigations along fruitful lines and to verify our conclusions, it is absolutely necessary to make comparisons at every turn, to study private industry just as carefully as public industry, and to measure the latter by the same standards which the industrial world applies to the former. Due weight will be given, as occasion may arise, to any peculiar or unusual conditions which frequently characterize certain phases of municipal ownership, and like allowance will be made for abnormal conditions, if such there be, in the private plants under consideration. Above all, an attitude of mental neutrality

will be maintained throughout. Though the writer will, whenever possible, point out what seem to be the correct conclusions and inferences to draw from the data under consideration, he is not only willing, but highly desirous, that the case shall be decided solely upon its own merits. His aim will be simply to present the truth in a clear way, without reading into his interpretations any personal prejudices.

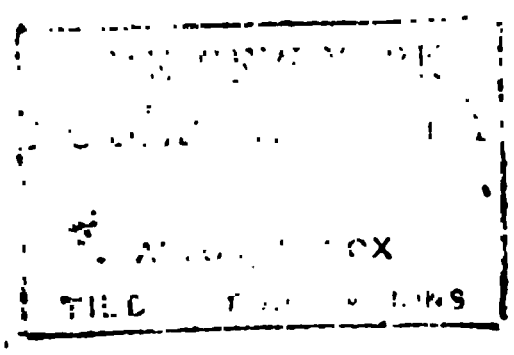
Probably no two electric lighting plants are in all respects fully comparable. A multitude of technical factors, external as well as internal, tend to disturb any nice theoretical balance which may be established. Though very similar physical conditions be found, yet the intangible items of management and coördination of effort on the part of employees may produce totally unexpected results. Our problem is slightly simplified, however, by confining the study to one small State, thereby eliminating numerous legal, psychological, and climatic differences. Certain general grounds of comparison, under the circumstances, are reasonably well defined, and, while any individual plant may vary greatly from the norm, the averages derived from the study of a sufficiently large group of similar plants will probably disclose the true conditions with sufficient accuracy for our purposes.

Central electric stations naturally fall into two groups, those producing current and those purchasing. Regarding the first class we wish to know further whether they generate all of their current or only part of it, and whether they do a composite business, gas, water, heating, or manufacturing, as well as an electric lighting and power business. Then we must consider the source of primary power, whether it be coal, fuel oil, water, or gas. Next the output of current is highly significant, as well as the load factor and the diversity factor,[1] which indicate pretty clearly the nature and extent of the business done as well as the

[1] For an explanation of these terms and their significance the reader is referred to the following chapter, pp. 97–98, 117.


73°
72°30′
72°
VERMONT
NEW HAMP
NEW YORK
North Adams
Williamstown
Winchendon
Ashburnham
Lunenburg
Franklin
FRANKLIN
Templeton
Leominster
42°30′
Sunderland
Mill River
Connecticut River
Princeton
BERKSHIRE
WORCESTE
West Boylston
Holden
HAMPSHIRE
Lee
Northampton
Paxton
South Hadley
Ware
North Brookfield
Spencer
Great Barrington
Holyoke
Ludlow
Westfield
Chicopee
HAMPDEN
42°
CONNECTICUT
GEOGRAPHICAL DISTRIBUTION
OF 72 ELECTRIC LIGHT PLANTS
IN MASSACHUSETTS (1914-1915)
★ Municipal Generating Plants (18)
o Municipal Purchasing Plants (21)
★ Company Generating Plants (17)
o Company Purchasing Plants (16)
41°30′
73°
72°30′
Longitude
72°
West

71°30'
71°
70°30'
70°
Amesbury
Merrimac
Newburyport
River
Groveland
Rowley
Georgetown
Ipswich
Merrimac
ESSEX
Gloucester
Groton
Ayer
Littleton
Middleton
Danvers
Manchester
Beverly
Peabody
Marblehead
Reading
Wakefield
Concord
MIDDLESEX
Hudson
Belmont
A T L A N T I C
O C E A N
Wellesley
SUFFOLK
Hull
Quincy
Hingham
Norwood
Braintree
Weymouth
Randolph
NORFOLK
Mansfield
Provincetown
North Attleborough
Plymouth
Taunton
PLYMOUTH
Attleborough
Middleborough
BRISTOL
BARNSTABLE
Buzzards Bay
Vineyard
DUKES
NANTUCKET
Citizens
42°30'
42°
41°30'
Greenwich



amount of necessary investment in station equipment. Finally, it is highly desirable to know the extent of the territory and the number of inhabitants served, the age of the plants compared, and whether or not there is competition of any kind.

Without referring in this connection to the many complicated engineering features of the business, there are numerous simple but very important considerations which should further be borne in mind if we wish the comparison to be complete. We should consider the proximity of the generating plant to navigable waterways and to sources of fuel supply. We should note whether equipment is all owned or partially leased. We should know the topography of the district served, the location of the central station, and the nature of the business which is carried on in the municipality. The traits and traditions of the inhabitants, the prevailing character of the local government and its requirements regarding the placing of lines underground, labor legislation and the unionization of labor, are all determining factors. Even more important are the nature of the management, — and "control" in the case of private plants, — the policy followed in the matter of repairs, improvements, extensions, and the securing of new business. These considerations, however, will be reserved till later in the discussion.

Groups of plants approximately equal in the six or seven fundamental respects must first of all be secured. The municipal plants are the fixed quantity in the problem, as *all* of them are to be studied. Hence it has been by no means a simple task to select private plants which will in most ways conform to the conditions outlined. Since the public generating stations are for the most part small, it has been rather difficult to find plants comparable in size. The result is that, with the exception of two or three very small plants the character of whose business and whose method of generating current and keeping accounts are

Table 12. General Information Regarding Company Generating Plants

Company	Date of Installation	Source of primary power	Current bought (per cent)	Nature of business	Competition	Number municipalities served	Character of municipality	Controlled
Amesbury	1893	Steam	1.2	Electric	Gas	2	Residential	Yes
Attleborough	1895	Steam	...	Electric	Gas	1	Manufacturing	Yes
Beverly	1888	Steam	...	Gas and electric	Gas	4	Manufacturing(?)	Yes
Buzzard's Bay	1910	Steam (and some gasoline)	0.3	Electric	None	5	Summer resort	Yes
Citizens' (Nantucket)	1888	Steam	...	Gas and electric	Gas	1	Residential	No
Gloucester	1888	Steam	...	Electric	Gas	3	Residential (?)	Yes
Great Barrington	1888	Water	32.5	Electric	None	3	Residential	Yes
Lee	1888	Water (and some steam)	74.2	Electric	None	2	Residential	No
Leominster	1888	Steam	31.7	Electric	Gas	1	Manufacturing	Yes
Newburyport	1887	Steam	...	Gas and electric	Gas	3	Manufacturing	Yes
North Adams	1885	Steam	...	Gas and electric	Gas	2	Manufacturing	Yes
Northampton	1886	Steam	...	Electric	Gas	1	Manufacturing	Yes
Plymouth	1888	Steam	...	Electric	Gas	4	Manufacturing	Yes
Quincy	1888	Steam	...	Electric	Gas	1	Residential (?)	No
Vineyard	1889	Steam	...	Gas and electric	Gas	3	Summer resort	Yes
Weymouth	1889	Steam (and some water)	...	Electric	Gas	1	Manufacturing	Yes
Winchendon	1889	Water	61.8	Electric	None	1	Residential	Yes

Table 13. General Information Regarding Municipal Generating Plants

Municipality	*Date of installation*	*Source of primary power*	*Current bought (per cent)*	*Nature of business*	*Competition*	*Character of municipality*
Braintree	1892 (Commercial, 1894)	Steam	....	Electric	Gas	Manufacturing (?)
Chicopee	1887 (Municipal, 1896)	Steam	52.4	Electric	Gas	Manufacturing
Concord	1900	Steam	....	Electric [1]	None	Residential
Danvers	1889 (Commercial, 1896)	Steam	....	Electric	Gas	Manufacturing
Holyoke	1888 (Municipal, 1902)	Steam and water	....	Gas and electric	Gas	Manufacturing
Hudson	1886 (Municipal, 1897)	Steam	....	Electric	Gas	Manufacturing
Hull	1893 (Municipal, 1894)	Steam	36.1	Electric	None	Summer resort
Ipswich	1903	Steam	....	Electric [1]	Gas	Residential
Mansfield	1904	Oil used exclusively	6.3	Electric	None	Residential
Marblehead	1895	Steam	....	Electric	Gas	Residential (Summer resort)
Merrimac	1904	Steam	....	Electric [1]	Gas	Residential
Middleborough	1889 (Municipal, 1893)	Steam, gas, and water	....	Gas and electric	Gas	Manufacturing
North Attleborough	1894	Steam	91.5	Electric [1]	Gas	Manufacturing
Peabody	1892 (Commercial, 1893)	Steam	....	Electric	Gas	Manufacturing
Reading	1895	Steam	....	Electric	Gas	Residential
Taunton	1882 (Municipal, 1897)	Steam	....	Electric	Gas	Manufacturing
Wakefield	1890 (Municipal, 1894)	Steam	83.7	Gas and electric	Gas	Manufacturing
Westfield	1887 (Municipal, 1899)	Steam	....	Gas and electric	Gas	Manufacturing

[1] Also to some extent connected with the municipal water system.

Table 14. General Information regarding Public and Private Purchasing Plants

Municipality	*Date of installation*	*Gas competition*	*Company*	*Date of installation*	*Date when plant ceased generating*	*Gas competition*	*Controlled*
Ashburnham	1904 (Mun., 1908)	None	Ayer	1898	1914	None	Yes
			Blackstone	1896	1904	Yes	Yes
Belmont	1898	Yes	Franklin	1886	1906	Yes	Yes
Boylston	1912	None	Harvard	1913	Never generated	None	Yes
Georgetown	1912	None					
Groton	1909	None	Ludlow	1908	Never generated	Yes	Yes (?)
Groveland	1907	Yes					
Hingham	1895	Yes	Manchester	1903	Never generated	None	No
Holden	1912	None					
Littleton	1912	None	Milford	1886	1901	Yes	Yes
Lunenburg	1914	Yes	Mill River	1903	1909	None	Yes
Middleton	1911 (Mun., 1913)	None	North Brookfield	1913	Never generated	Yes	Yes
Norwood	1907	Yes	Provincetown	1904	1914	None	Yes
Paxton	1914	None	Randolph and Holbrook	1897	1914	Yes	Yes
Princeton	1912	Yes	Shirley	1904	1914	None	No
Rowley	1910	None	Spencer	1886	1914	Yes	Yes
Shrewsbury	1908	None	Sunderland	1906	1907	Yes	Yes
South Hadley	1888 (Mun., 1914)	Yes	Ware	1887	1914	Yes	Yes
			Williamstown	1903	Never generated	Yes	Yes
Sterling	1911	None					
Templeton	1907	None					
Wellesley	1892 (Com., 1906)	Yes					
West Boylston	1911	None					

TABLE 15. COMPARATIVE AVERAGES OF THE TWO GROUPS OF PLANTS

	Companies	*Municipal (Holyoke out)*
I. Generating plants:		
Capacity (K.W.) of dynamos	1,366	951
Output (K.W.H.)	1,764,719	1,163,110
Disposal of current (percentage):		
Commercial and domestic lighting	30.6	31.0
Street lighting	14.3	24.3
Power	42.7	43.8
Other companies	12.4	0.9
Load factor { arithmetical average	(14) 27.7	(13) 25.5
Load factor { weighted average	(29.2)	(23.5)
Customers	1,377	1,063
	(1,205)[1]	(1,030)[1]
Population of district served	16,817	12,113
	(14,354)[1]	(11,768)[1]
Area of district served (sq. m.)	58.94	24.81
	(30.67)[1]	(21.39)[1]
Density of population	285.3	488.2
	(468.1)[1]	(550.2)[1]
Age of plants (years)	25.2	(18) 22.2
		(18.3)[2]

	Companies	*Municipal (Norwood out)*
II. Purchasing plants:		
Output (K.W.H.)	266,715	157,173
Disposal of current (percentage):		
Commercial and domestic lighting	45.2	54.6
Street lighting	21.0	31.3
Power	31.3	13.9
Other companies	2.5	0.3
Customers	376	289
Population of district served	5,467	2,679
Area of district served (sq. m.)	25.06	19.60
	(19.88)[1]	
Density of population	218.2	136.7
Age of plants (years)	15.4	8.0
		(6.5)[2]

[1] Excluding foreign districts served.

[2] Age under public ownership.

such that comparison is out of the question, *it has become necessary to choose the smallest and in many cases the more poorly managed companies*. Accordingly, 17 of these are compared with the 18 municipal plants which generated all or a portion of their current during the year ending June 30, 1915. No private plant so large as Holyoke has been included, as it is by no means typical of public plants in the State. The averages are usually computed both with and without Holyoke.

Two public plants bought the greater part of their current during the year, one bought about half, and another one third of its total output. To compare with these, four companies have been found whose proportion of purchased current is practically the same. One municipal plant uses only oil for fuel, and two use considerable water power. Among the private plants selected there are two very small ones using solely water power, two using some water power, and one using a little gasoline. The two generating current only by water power have been included merely because they are small. For this reason, and inasmuch as they buy most of their current, they will not distort the averages for the group. For comparison with the four public plants doing both a gas and an electric business, five similar companies have been taken, the additional one simply because it is very small. Seven municipal plants and four private ones sell some steam for sundry purposes.

While the output of the 17 generating companies averages somewhat higher than that of the public stations (Holyoke being excluded), this difference is probably not great enough to have any marked effect upon our comparisons. Whenever this fact may become significant due allowance will be made therefor. So far as the load factors are concerned, they average about the same for the two groups, though in several cases no data are returned which enable them to be computed. With a very few exceptions, it is impossible to find the diversity factor.

Some difficulty was encountered in looking for sufficiently small population groups in the case of private plants. This matter in itself is not highly important; but when other conditions seemed equal the plant serving the smaller population was selected. The question of competition of other central stations can hardly arise under the Massachusetts law. It is interesting to note, however, that all but 4 of the companies and all but 3 of the public plants have a competing gas business in their territory. The 17 companies do business in 38 different cities and towns, 9 of them supplying a total of 30 municipalities, and the 18 public plants in only 22. Geographically, the relative distribution of the two groups of plants is about the same.

Upon examination of the ages of the two groups, it appears that 16 of the companies and 15 of the municipal plants began operation before 1900, and 14 companies and 7 municipal plants (at that time all privately owned but one) before 1889. The average age of the two groups is thus not far apart, but the average length of time under municipal ownership, 18.3 years, is nearly 30 per cent less than the average age of the companies, 25.2 years. According to the census of 1910,[1] 10 of the cities and towns in which the companies are located, having a population greater than 10,000, did a considerable amount of manufacturing. Though only 6 of the municipalities having their own plants were five years ago in this population group, they all did a large manufacturing business, 4 of them ranking much higher than the places served by private plants. At least 3 more municipalities should be added for 1915.[2] The total for the two groups thus becomes practically the same. Finally, voluntary associations or groups of investors control 14 of the companies.[3]

[1] Abstract, U.S. Census, 1910 (with Supplement for Massachusetts): 648; also Mass. Stat. Mfg., 1914: 12–47.

[2] Mass. Stat. Mfg., 1914: 12–47. [3] Cf. Mass. G. & E., xxxi: 12–13.

As several of the 21 municipal plants purchasing their current do so minute a business, it was scarcely possible to find a sufficient number of very small companies to compare with them. However, 16 were selected, although two or three of the smallest companies had to be eliminated because of the fact that the records which they keep are unsatisfactory. Otherwise, as in the case of the generating plants, *the least and most inefficient private business has been compared with public business as it is.*

When only a distributing system is operated, the problem of comparison is much simplified. The average output, very small in either group, is nearly enough the same to make comparisons valid. Load factors cannot be compared, because with two or three exceptions public plants return no data on this point; but all in each group except one give both day and night service. The 16 companies do business in 22 different towns, while the municipalities confine their business to their own limits. It is rather surprising to find 10 of the municipal and 5 of the private plants in Worcester County. Also, 14 of the companies are controlled by voluntary associations.[1]

The average population served by the private plants is approximately double that served by the municipalities. There is gas competition in the case of 10 of the companies and 8 of the municipalities. Three of the former, Blackstone, Spencer, and Williamstown, do a little gas business themselves. The average age of the municipal purchasing plants is considerably less than that of the companies. Of the latter, 12 began operation before 1905, while only 5 of the public plants, 2 of which were then under private ownership, were operating before this date. It must also be noted that 11 of the companies, nearly 70 per cent, formerly generated current, 6 ceasing to do so in 1914. Only 2 of the 21 municipal plants ever produced current, and that was when they were privately owned. Finally,

[1] Cf. Mass. G. & E., xxxi: 12–13, and 3a–32a.

since Norwood occupies the same relation with respect to this group of public plants that Holyoke occupies with respect to the other group, — doing one third of the aggregate business, — it has been kept separate in computing the averages, and for the reasons already given no correspondingly large company has been selected.

The fiscal year 1914–15 has been taken for the more intensive study of the subject because, when the work was begun, no later returns were available. As this is a census year in Massachusetts, it is convenient for our purposes. On the other hand, due to certain abnormal market conditions resulting from the European war as well as to unexpected contingencies, some of the records for this date may not be fairly representative. In most instances any individual differences will be minimized in the averages, and group differences would tend to be the same in the two cases. Yet, in order to present the subject with as much accuracy as may be attained, single items are, in doubtful cases, traced back over a period of years. Furthermore, so that the investigation may be still more conclusive, the year 1909–10 has also been selected for careful study of all plants generating current. Accordingly, the relative changes which have taken place in the five-year period will, whenever possible, be pointed out. Before this date, particularly for the public plants, a good deal of the data returned are of such a nature that they can only with the greatest difficulty be utilized. This five-year comparison is not at present attempted in dealing with the purchasing plants, for almost half of the companies chosen were still generating current in 1910, and only 9 of the 21 municipal plants were then in operation, most of them not yet "seasoned." Under these circumstances, such a comparison would lead to no definite results.

An attempt will be made to study the subject in its physical, financial, and developmental aspects. Attention will be given to as many of the engineering features as seem

necessary for our purpose, to the technical, statistical, and historical aspects of the problem, as well as to certain questions of accounting. But theoretical questions will frequently be raised, practical considerations will be constantly stressed, and matters of public policy will not be overlooked. As nearly as may be, only really comparable data will be compared. Disturbing differences will if possible be eliminated, or, in lieu of this, reasonable allowances will be made. While eschewing the futile quibbles frequently indulged in by narrowly trained accountants and by over-specialized engineers, the writer hopes to avoid the even more serious dangers of ill-considered and superficial generalization which have characterized most studies of the problem of municipal ownership. The reader will have to be the judge of the fairness of the methods followed.

Finally, due weight will be given to the numerous "intangible items" which no returns can show, but which are highly significant in any investigation of the problem of public ownership. Of much greater importance, however, the local background will be carefully studied, so that the conclusions reached by means of an impartial analysis of all available statistical material, will be checked and supplemented and clothed with some degree of life, as a result of a reasonably thorough first-hand knowledge of the situation, secured through a local, personal survey of the plants under consideration. The results arrived at by these different methods should at least enable us to form *some* satisfactory judgments on certain aspects of the problem of municipal ownership, and may, perchance, furnish us with some clue to the possibilities of public industry on a more extensive scale.

In conclusion, attention should again be called to the fact that existing circumstances have made it necessary to compare public business as we find it with private business in many cases at its worst in the State. Consequently,

if municipal ownership shall appear to hold its own, the reader can rest assured that it has been given the benefit of any doubt which might arise; and if the results are found to be unfavorable, the case against municipalization as a general policy will be thereby the stronger.

CHAPTER IV

PHYSICAL STATISTICS, ANALYSES, AND COMPARISONS

WHILE it is not the purpose of the writer, in this study, to deal with the many intricacies of electrical engineering, yet it is necessary to know generally how the selected groups of public and private plants compare with respect to their physical equipment, development, and operation, before we can be in a position to interpret correctly the numerous financial data which must be considered in an investigation of this kind. Accordingly, we shall begin with the stations themselves, studying, at this stage, only the generating plants.[1]

[1] The present chapter, for the most part, naturally deals with the generating plants. Unless necessary for the sake of clearness, data given at length in the appendix will not be tabulated in brief in the text. The plants doing both a gas and electric light business have been kept separate from the purely electric plants, and whenever occasion seems to demand, attention will be called to any abnormalities which they may present. Except when so indicated, Holyoke is not included with the public plants when totals are given and comparisons made; the reasons for this omission are self-evident.

Finally the reader must be mindful of the fact that all of the data herein presented have been worked over by the writer from many angles before they have reached their present form. The returns themselves give no totals, make no analyses, work out no relations, and much highly important information is conspicuous by reason of its absence. In many instances it has been necessary to ferret out valuable material from various state bureaus. The work has further been very much complicated by including the year 1910 in the study, and the labor of computation and presentation has thereby been increased many fold. Frequently, also, when the returns of 1910 proved unsatisfactory in certain points, it has been necessary to use the data given in the succeeding returns instead. These irregularities call for the utmost care in computing the averages so that the case will be truly presented. In view of these difficulties, it would indeed be surprising if many errors have not crept into the calculations herewith appended. The writer is confident, however, that these errors are not of such a character that they will in any respect invalidate the general reasoning developed in this study.

1. Station Equipment [1]

At the present time (1915) the total number of boilers in the 15 reporting municipal plants (47) is about 72 per cent of the total for the 16 private plants reporting this item (65), while the total horse power of their boilers (8,353) is about 60 per cent of that of the latter (13,874). Hence the average size of boilers is 20 per cent greater in the companies than in the public plants (213 H.P. *vs.* 178 H.P.)[2] The average number of boilers per public plant is three fourths of the average number found in the private plants (3.1 *vs.* 4.1). It is significant to note that the relative average capacity of boilers has remained almost constant during the past five years, the rate of increase having been practically equal in the two cases, so that the absolute difference has been left the same. However, though the absolute figures are ridiculously small, 9 and 2 respectively, the *number* of units has increased much more rapidly for the private plants, leading to a correspondingly more rapid growth of boiler capacity per plant for the period, until now the average capacity of the municipal plants is only 64 per cent of the average for the companies whereas in 1910 it was 71 per cent.

One public plant, Mansfield, uses oil engines, and another, Merrimac, rents its steam station from the town waterworks and reports no boilers. A third plant, Middleborough, does practically all of its generating by gas engines and by water wheels, and consequently reports an abnormally low boiler capacity (25 H.P.). One company, Winchendon, has never used any motive power but water, and two others, Great Barrington and Lee, have always generated largely by means of water wheels. For some time they have all bought a large portion of their current. Hence these plants report a disproportionately small amount of

[1] Appendix, pp. 394–395.

[2] Unless other explanation is given, the averages used throughout are fully weighted arithmetical or "group" averages. Cf. Appendix, p. 391.

horse power. The conditions for the two groups are relatively the same in this regard.

Upon further analysis, it appears that the total rated horse power of one of the companies has decreased very slightly, and three have remained unchanged during the five-year period. Hence 75 per cent of this group have gained in boiler capacity during the period. On the other hand, 3 of the municipal plants show a clearly marked decrease in rated horse power, while 5 remain unchanged. Of these 8 plants, 2 bought nearly all of their current during the year. Expressed in other words, more than 58 per cent of the public plants have remained stationary or have gone back so far as their total boiler capacity is concerned. Furthermore, exactly 60 per cent of the total increase in rated horse power for *all* of the municipal plants (1100 H.P. out of 1841 H.P.) is accounted for by the one large plant of Taunton. If Holyoke is included, the averages for the two groups become practically identical.

The total horse power of prime movers for the public plants is equal to 70 per cent of that for the companies, though the actual number of their units is nearly 90 per cent of the latter. The average horse power of the primary power machines is more than one fifth less in the case of the public plants than in the private plants. The rate of increase, both in numbers and in total horse power, has been almost identical in the two groups. However, 6 of the municipal plants have shown no growth in this regard during the five-year period, and one has shown an actual decrease in horse power. Of the companies, 3 have remained stationary and 2 have decreased slightly.

Table 16 indicates clearly the relation which the different kinds of prime movers bear to each other. It appears that the number of steam turbines is considerably greater in the private plants and that their average horse power is less. If, however, the two large turbines of the municipal plant of Taunton (2,300 H.P. each) be omitted, the aver-

TABLE 16. CHARACTER OF PRIME MOVERS

Type	Companies		Municipalities		Average H.P.	
	Number	Horse power	Number	Horse power	Companies	Municipalities
Steam engines.....	37	17,958	38	10,459	485	275
Steam turbines.....	16	11,750	10	10,008	734	1,001 (676) [3]
All others [1].....	11	1,269	9	935	115	104
Total	64	30,977	57 [2]	21,402	484	376

[1] This includes, for the companies, 8 water wheels and 3 gasoline engines; and, for the municipalities, 2 water turbines, 4 oil engines, and 3 gas engines.
[2] Wakefield omitted; ceased making current. [3] Taunton omitted.

ages are not far apart. The average horse power of *steam* engines of the companies is about 75 per cent greater than that of the public plants.

For the general student of the problem, the kilowatt capacity of dynamos is of more significance than the horse power of boilers and prime movers. In 1915 the total rated kilowatt capacity of generators of the 17 municipal plants was 30 per cent less than that of the corresponding number of companies, the number of dynamos was 20 per cent less, and the average capacity per dynamo was nearly 15 per cent less.[1] Practically all of the generators were of the alternating current type, less than 2 per cent in either case being represented by direct current units.[2]

[1] The accuracy of the returns in the matter of rated kilowatt capacity of dynamos is frequently open to question. Upon careful examination of the data, when available, the writer has found that the capacity is sometimes returned in kilovolt-amperes instead of kilowatts, as called for in the returns. But, unless the power factor should be unity — a condition not found in the smaller plants — the former rating would be too high, depending upon individual conditions. As the data are by no means satisfactory on this point, and as the errors would probably be about equally divided between the two groups, the writer has adhered to the rating as given in the returns.

[2] It is interesting to note that alternating current generation has constantly been displacing the earlier direct current generation. This is due largely to the greater economy and convenience in distribution which

The development between 1910 and 1915 presents some interesting contrasts. In the first place, the total number of dynamos decreased nearly 8 per cent in the public plants and 24 per cent in the companies. The total kilowatt capacity increased 43 per cent in the former and 52 per cent in the latter; while the average kilowatt capacity per dynamo increased nearly 55 per cent in the municipal plants and 100 per cent in the group of private plants. These figures indicate that the companies have increased their absolute capacity more rapidly than have the municipalities, and that, while they had a disproportionately large number of very small D.C. generators in 1910, these have been almost wholly displaced by the installation of a small number of large A.C. dynamos. *For both of these reasons we would expect a considerable increase in station investment for the companies during this period.*

The number of small arc light and power generators was, in 1910, almost negligible in the case of the municipal plants, probably due to the fact that, in most instances, their equipment was of more recent installation than that of the companies. On this point it will be recalled that all of the older public plants were taken over from private ownership, and when the transfer was effected a good deal of the old equipment was scrapped. The large number of these out-of-date generators returned by the companies at this date reduces their average capacity per dynamo to only 158 kilowatts, or about 9 per cent less than that of the public plants. In 1915, the public plants returned 4 D.C. generators with a total capacity of 298 kilowatts, and the private plants report 10 of these, having a total

characterizes the alternating current, since it can be transmitted over long distances at a high voltage and a low amperage, thus occasioning the minimum line losses. Furthermore, this current can be "stepped down" or "up," if need be, by means of transformers, so that it becomes available for practically every kind of light and power service. Direct current, on the other hand, cannot be "transformed," and is subject to great loss in distribution.

capacity of 436 kilowatts. Were these small generators omitted in both groups, the average capacity per A.C. dynamo would be 21 per cent less for the municipal plants than for the companies (283 K.W. *vs.* 356 K.W.). Finally, 4 of the public plants report no increase in capacity during the period and 2 have had a decrease, while 3 companies show a decrease and one has remained unchanged. As Holyoke increased its capacity by more than 50 per cent during the year, the inclusion of its figures would be misleading.

In this connection attention should be called to the correspondence which exists between the relative average capacities of boilers, prime movers, and generators in the two groups. Reducing kilowatts to horse power when necessary, we find that the relations are as follows: —

TABLE 17. RELATIONS EXISTING BETWEEN THE STATION UNITS

Item	*Boilers*	*Prime movers*	*Dynamos*
Average capacity of units (H.P.).....			
Companies.....	867	1,822	1,830
Municipalities.....	595 [1]	1,274	1,274
Ratio			
Companies.....	1.0	2.10	2.11
Municipalities.....	1.0	2.14	2.14

[1] Middleborough omitted.

These data suggest that the engineering conditions for the two groups of plants, so far as can be ascertained from the returns, are almost identical. Having examined the date of installation of the various units, however, the writer finds that their average age is 7.6 years for the companies and 9.1, or 20 per cent greater, for the municipalities. *Tentatively, then, we may conclude that the private plants have been kept in better repair than the municipal plants.* On the other hand, some may argue that the equipment of public

plants has been so well maintained that it has not needed as frequent replacement as that of the companies. This view seems hardly consistent with the facts as we know them, and the local survey has amply proved the truth of our tentative conclusion.

Further analysis reveals the fact that the *per capita* rating of the stations has increased with equal rapidity in the two groups during the past five years, from 63 watts to 83 watts for the public and from 61 watts to 81 watts for the private plants. The rating per customer, on the other hand, has decreased in a fairly equal ratio, 26 per cent in the case of the public plants and less than 23 per cent for the companies. Hence, it is apparent that, while the two sets of plants have outstripped the population in their growth of generating capacity, they have by no means kept pace with the increase in number of customers. This fact probably indicates, for the most part, an improved diversity factor, and incidentally a better load factor, so that a given amount of generating equipment can render proportionately greater service. This, again, suggests that a number of small "off peak" customers, using current for power, cooking, heating, etc., have been secured. And, finally, the fact that the per customer rating of municipal plants has decreased somewhat more rapidly than that of the companies, *may* indicate that the former have avoided the poorer business, and have endeavored to extend their service only to the more desirable class of customers. In other words, municipal plants have doubtless been less active in going after new business than have the private plants. In many cases they have probably waited for the trade to develop instead of aiding in that development. On the other hand, the difference can largely be accounted for by the growth in power business of the public plants. Though these figures in themselves are far from conclusive, there will be occasion later to refer to this matter in other connections.

2. Fuel Consumption [1]

While 15 of the municipal plants using only coal for generation consume on the average 4.69 pounds of coal per kilowatt hour generated, 12 of the companies use exactly 4 pounds per kilowatt. A small amount of coke and screenings is used by both groups, and the quality and price in individual cases vary widely. With so large a number, however, the average conditions are about the same. The advantage which the companies seem to have is due partially to the economies arising from the generation of a larger amount of current per plant (1,650,091 kilowatt hours as compared with 1,024,023 kilowatt hours generated by the public plants), and partially to the somewhat better load factor. How much of the difference is due to other causes, such as more efficient engineering and better quality of coal, can only be guessed at. The writer should state, however, that the local survey has disclosed the fact that the companies, as one might expect, are in the main better supplied with the various economic devices, automatic stokers, carbon dioxide recorders, economizers, etc., which help to conserve the fuel supply.

Expressed in other words, the number of watt hours generated per pound of coal averages 213 in the public plants and 250 in the companies, a difference of 37, or 17.5, per cent. A study of the accompanying chart, however, persuades the writer that the difference is not much greater than might normally be expected as a result of disparity in the quantity of current generated. While the graph of the public plants shows a surprising irregularity for plants between 600,000 and 1,000,000, this is caused almost wholly by two exceptional cases, and after the 1,000,000 mark is reached, we have a delightfully smooth curve, slowly ascending to the right. On the other hand, the graph of the companies appears very even up to 1,000,000, due to

[1] Appendix, pp. 440–441.

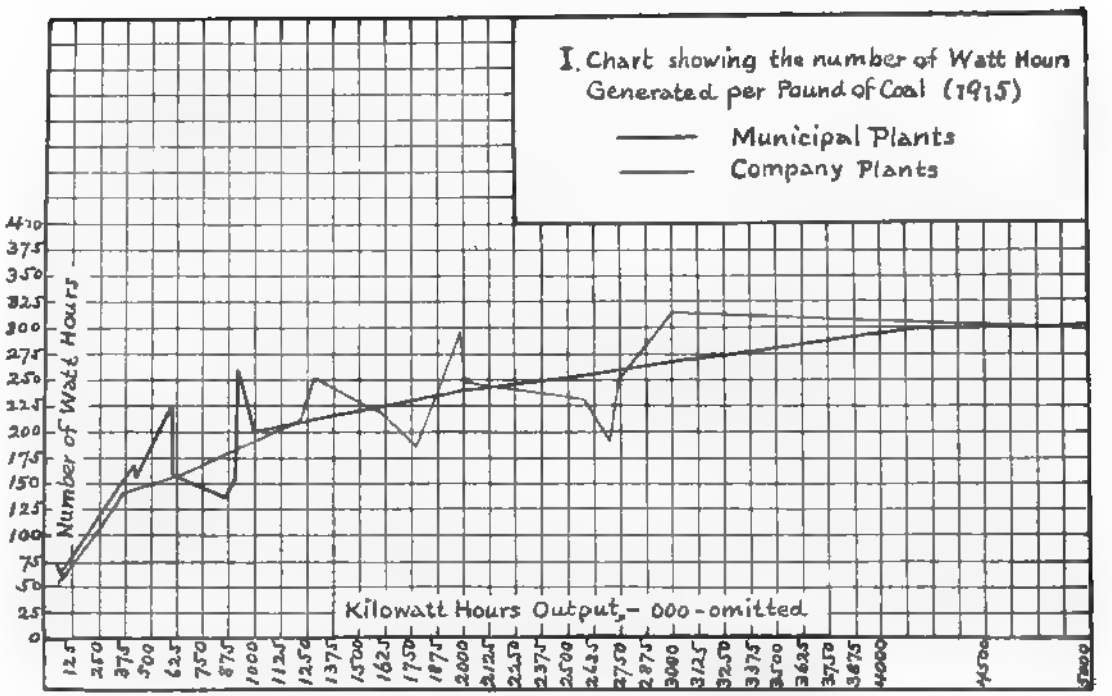
the fact that the number of plants in this class is very small, only 3 as contrasted with 10 of the public plants. After the 1,000,000 point, it zigzags about the first graph, constantly approaching it as a norm. For plants generating slightly more than 1,000,000 kilowatt hours, the lines meet at a point indicating that not much more than 200 watt hours are produced per pound of coal. They again come close together near the 2,000,000 mark, at a point somewhat under 250. When the extremes of the private plants are averaged, they approach surprisingly near the more even graph of the public plants. It is scarcely necessary for our purposes to attempt to explain the several individual irregularities when the averages so closely approximate each other. In a number of cases, however, they are caused by a difference in the fuel value of the coal used. Hence, this chart should be studied in connection with a later one showing the unit costs of coal.

It is worth noting that the same group of private plants, while increasing their average output more than 50 per cent during the five-year period (from less than 1,300,000 to almost 2,000,000 K.W.H.), reduced the amount of coal consumed per kilowatt hour by about 10 per cent (from 4.434 pounds to 4 pounds). The municipal plants likewise increased their output almost 50 per cent (from 686,000 to more than 1,000,000 K.W.H.), and decreased the quantity of coal used from 6.356 to 4.69 pounds per kilowatt hour generated, or about 26 per cent. The relative size of the two groups of plants accounts largely for the greater decrease in coal consumption in the case of the municipal plants, though it seems probable that the generating efficiency of the latter was unnecessarily low in 1910.

3. Output and Disposal of Current [1]

In 1915, the average output of the 17 municipal plants, including current purchased as well as generated, was

[1] Appendix, pp. 396–403, 406–407, 422.


I. Chart showing the number of Watt Hours Generated per Pound of Coal (1915)
Municipal Plants
Company Plants
Number of Watt Hours
Kilowatt Hours Output, - 000 - omitted

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1,163,110 kilowatt hours. The average output of the companies was about 52 per cent greater, or 1,764,719 kilowatt hours. In 1910, however, the companies led by 67.5 per cent, the averages being respectively 658,488 and 1,103,075 kilowatt hours. The public plants purchased 12 per cent of their current, and the other group 6.5 per cent, while in 1910 the respective amounts purchased were 1.3 per cent and 4.1 per cent.

Due to the way in which the records are kept, it has been difficult to get the load factors of the plants studied. Only two or three of the plants return a load curve, and none of them work out their load factors, as this is not required by the Board. Hence, the data with which one has to deal are very irregular. Three companies and three public plants report only the maximum day's output in kilowatt hours. One company and three public plants report the maximum demand in amperes instead of in kilowatts, giving no station voltage; while one public plant gives no data whatever bearing on this point. Accordingly, three of the companies and four of the municipalities must be disregarded in this portion of the study. However, the voltage of the plants reporting in amperes was ascertained and the load factors roughly computed accordingly.[1] The arithmetical average of the load factors of the 14 plants in each group is, for the companies, 27.2, and for the municipalities, 25.9.[2] If, however, Holyoke be omitted, the lat-

[1] These voltages are, for the public plants, Hudson, 1,100, Reading, 2,300, Middleborough, 1,100, and for the one company, Vineyard Lighting Co., 2,300. As the power factor is unknown, these load factors are little more than estimates.

[2] The *load factor* here used is the standard one, being simply the ratio of average to maximum demand for the year. The formula for computation is

$$\text{load factor} = \frac{\text{yearly output}}{\text{peak load} \times 8760 \text{ (no. hours in yr.)}}$$

The returns do not show the length of the peak load, but it is doubtless approximately the same for the two groups.

ter becomes 25.5. The weighted averages, which probably more nearly indicate the true relation, are 29.2 for the companies and only 23.5 for the municipalities. This, of course, shows that, other conditions being equal, the companies are being operated more efficiently than the public plants, in that their investment is working for them a correspondingly greater portion of the time.

The maximum demand factors are, for the companies, 49.4, and for the public plants, 62.9.[1] These figures may show that the latter are following a more conservative policy than the former with respect to the enlargement of their generating capacity. This disparity is somewhat increased by the fact that the public plants are buying proportionately more of their current than the companies, and hence actually need a correspondingly smaller amount of dynamo capacity; but this is sufficient to account for only a small part of the difference.[2]

The average daily amount of current generated by the group of municipal plants in 1910 was 30,269 kilowatt hours, and 47,700 hours in 1915. At the same dates the daily averages for the companies were 49,245 and 76,854 kilowatt hours. Also, the total kilowatt capacity of generators was, for the municipal plants, 11,297 and 16,166 in the respective years, and for the companies 15,281 and 23,221. Studying these data, we find that in 1910 the public plants actually produced only 11.1 per cent of the total current which with their equipment they *could* have produced. In other words, their output (purchased current deducted) was on the basis of about two and two

[1] The *maximum demand factor* used by the writer is the ratio of the peak load for the year to the total rated capacity of the generators. In this case, of course, arithmetical averages are used.

[2] Unfortunately we know nothing definite about the *diversity factor* — the ratio between the sum of the individual *maxima* and the *maximum* of the system — for these small plants. It may be observed in passing, however, that the more the diversity factor exceeds unity, the greater is the number of customers which can be served by means of a given generating capacity.

thirds hours' use per day of the maximum capacity. The companies showed only a slightly better figure, 13.4 per cent, or three and one fifth hours' use per day of their maximum generating capacity. In 1915 conditions had changed but slightly. The municipalities had increased their percentage of *possible* output to 12.3, or three hours' use of their maximum, and the companies had crept along to 13.8 per cent, equivalent to three and one third hours' use. This analysis indicates a rather excessive amount of idle investment in generating plants, but the conditions are very similar in the two groups.

The average output per day for each plant stands at 4,835 kilowatt hours for the companies and 3,187 for the municipalities. The ratios of the average load, purchased current being deducted, to the average rated station capacity, are respectively 30.2 per cent and 33.9 per cent. The yearly amount of current generated per kilowatt capacity of dynamos is 1,207 kilowatt hours for the companies and 1,077 for the other group, while in 1910 it was 1,176 and 978 respectively. With a better load factor on the part of the former and with some dynamos practically out of use in the latter, these figures are to be expected. Finally, the ratio of the maximum load on the day of least output to the maximum station load, is, for the public plants, 27 per cent, and for the companies, 26. This is an unusually close correspondence, which in turn suggests that the conditions of business in the two groups are very similar.

These figures, however, as well as most of the other data dealing with the load, should be taken with a good deal of caution, for it is by no means certain that the returns are correct in this regard. This is particularly true of the smaller public plants, whose station meters have sometimes not been tested for years.[1] One public plant, Ipswich, and one company, Buzzard's Bay, note in the returns that they have for the most part estimated their output of current.

[1] Cf. ch. xi, pp. 301–302.

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Probably some others have done a good deal of estimating without mentioning the fact. *Prima facie* the writer would expect these conditions to be worse in the case of the public plants, since they include a larger number of small stations. Even here, however, the errors might about balance each other, and it is safe to assume that the figures given are a fairly close approximation to the truth.

The percentage of the total output used at the station for light and auxiliaries, and unaccounted for,[1] was 18.5 for the companies and 24.2 or comparatively 31 per cent higher, for the public plants. As the amount used at the station by the former is 4.9 per cent of the total, the actual current unaccounted for is 13.6 per cent, whereas the public plants report 3.6 per cent used at station and 20.6 per cent unaccounted for. This is a rather noticeable discrepancy, particularly in view of the fact that in 1910 these items amounted to only 21.5 per cent for the public plants, and were somewhat higher, 22.2 per cent, for the companies. In five years the total unaccounted for and used at station has increased only 31.6 per cent in the companies and 98.0, or more than three times as rapidly, in the municipalities.

From an examination of the table in the appendix[2] it appears that the municipal plant of Chicopee reports an abnormally large amount of unaccounted for, 44 per cent, and Mansfield 41 per cent. Hence, if we deduct these high extremes in computing the average, the total unaccounted for becomes only 21.1 per cent for the public plants, or about the same as in 1910, which is still far ahead of the

[1] As called for in the returns, the expression "unaccounted for" means the difference between the total amount of current generated and purchased and the total amount delivered to all consumers together with that used at the station. Sometimes, however, particularly in 1910, the quantity of current "used at station" has not been given, and is accordingly included in the "unaccounted for." This leads to a difficulty which there seems to be no means of avoiding.

[2] P. 396.

companies. But, on more careful scrutiny, we find that the municipal plant of Westfield returns an incredibly low quantity of unaccounted for, 4 per cent, — surely the result of mistaken metering. If this low extreme be omitted, the average mounts to 23 per cent. But if we make these adjustments for the municipal plants, we must also apply the same corrections to the companies, two of which report a very much higher amount of unaccounted for than any of the others, Amesbury 32.4 per cent, and Great Barrington 33.8 per cent. Eliminating these plants, we get an average of only 17.4 per cent of unaccounted for in the case of the private plants. Upon comparing this average with the corrected average of the public plants, 23 per cent, we find the relative difference against the latter to be more than 32 per cent, slightly greater than before any corrections were made! Or, if Westfield be retained in the municipal plant averages, as it surely should not be, the difference is reduced to something more than 21 per cent. More significant than any of these averages, however, is the fact that only 4 of the companies report an amount of current used at station and unaccounted for in excess of 20 per cent, and in 6 this item is 15 per cent or less. Of the public plants, on the other hand, 12 have losses higher than 20 per cent, and only 2 report under 15 per cent.

To be sure, there is always a shrinkage of current between bus-bars and consumers' meters. These losses may be occasioned by numberless causes. There are line losses due to defective insulation, resistance of circuits, foliage contacts, and atmospheric conditions. Then there are meter and transformer losses, perhaps due to inaccuracy in the former and to overloading in the latter. Sometimes the lines are tapped and current is actually stolen. Station meters, as well as customers' meters may fail to register properly,[1] and there may be clerical errors in the records.

[1] On this point see ch. XI, pp. 308–309. The station meters of the public plants are sometimes very undependable. In some instances, also,

The nature of the load is also very significant. Yet, as external conditions seem to have remained about the same and in many cases markedly to have improved for the public plants, this greater leakage of current is probably caused largely by bad engineering. It would appear that the distributing system had not been properly maintained and improved during the past few years. Though the quantity of current sold by an electric lighting plant can never be equal to the amount generated, yet the aim should always be to keep the "efficiency of distribution factor" as near unity as possible. In the two groups, however, this factor is 81.5 for the companies, which operate by far the more extensive distribution system, and only 75.8 for the municipalities. While Holyoke makes a better absolute showing than most of the other plants, its current unaccounted for has doubled within the past five years, though its output has increased only 50 per cent, and *this* in spite of the fact that its territory and business are the most desirable of all. While engaged in the local survey of the plants herein discussed, the writer was constantly told by managers of the companies that probably the greater losses of current reported by the municipal plants might be occasioned by the fact that smaller line transformers are used by them than by the companies. In order to test the truth of this supposition the average size of transformer used by each group of plants was computed, as well as the relative proportions which the numbers of certain sizes bear to the total. These data are set forth in Table 18.

It appears that in 1915 the average size of transformer was 6 kilowatts for the municipal plants, Holyoke excluded, and 6.45 kilowatts for the companies — a remarkably slight difference, which in itself could scarcely explain the difference in current unaccounted for. It is true, however,

there is a strong presumption that customers' meters have been tampered with for the purpose of causing them to register a smaller quantity of current than was actually delivered.

TABLE 18. TRANSFORMER DATA (GENERATING PLANTS, 1915)

Class of plant	Average size (K.W.)	Percentage distribution of the different sizes of line transformers				
		1 K.W. or less	1+ to 3 K.W.	3+ to 5 K.W.	5+ to 10 K.W.	Over 10 K.W.
Municipal.....	6.00	27.0	30.0	15.8	14.1	13.3
Company.....	6.45	24.1	33.0	18.5	12.2	12.1

that the individual cases vary greatly, and that the smaller transformers are frequently accompanied by the larger losses. But it might be argued that, even though the averages are close together, this is because the numerous small transformers of the public plants are counterbalanced by a few very large ones. Now, it is shown that the percentages of the various sizes correspond with reasonable closeness in the two groups. Yet there may be a little truth in the assumption just made, for the percentage of the smallest size in the municipal plants exceeds that of the companies by 12 per cent, and the percentage of the largest size exceeds that of the companies by 10 per cent.

While it may be that the *proportionately* greater number of transformers under 1 kilowatt accounts for part of the higher losses, it is probable that these losses are due more to the older and inferior types of instruments frequently used by the public plants. This, in turn, is often a result of a short-sighted financial policy which leads to the retention of old equipment, even at a loss in current, in order to avoid the investment in newer apparatus which will cause the construction accounts to be written up. In many instances the public have themselves willed a false economy in this regard.[1]

[1] So far as the average price of transformers is concerned, that does not seem to throw much light upon this aspect of the case. It is $60 for the companies, and $60 for the municipal plants — or $68, if we use the gross cost account instead of the plant account (depreciated).

Finally, two additional possibilities remain. In the first place, many transformers may be operated at "light load" for a longer period of time in the public plants. While many companies follow the policy of "cutting out" as many as possible of their transformers at certain seasons of the year, thus greatly reducing their "light load losses," it is very probable that the other group, not so much concerned about the amount of current lost, since there are no stockholders to placate, do not take this precaution.[1] In the second place, the latter may overload their transformers, and consequently overheat them, to such an extent that the core losses are greatly increased.[2] As a matter of fact the writer has found that both of these difficulties were formerly very common among the municipal plants.

From 1910 to 1915, as previously indicated, the output of current in the public plants increased 76.5 per cent, or only 65 per cent if Holyoke is included. The output of the companies increased only 60 per cent, or 57 per cent if we omit Buzzard's Bay, which was just beginning operations in 1910. The current delivered to consumers, on the other hand, increased 70.1 per cent in the case of the public plants (58 per cent, including Holyoke), and 68.2 per cent in the private plants (65.2 per cent with Buzzard's Bay out). Hence the relative total increase in current supplied has been practically the same. The evident disparity between increase of output and increase of sales results from the decided reversal of position between the two groups in the matter of current used at station and unaccounted for.

Table 19 presents some interesting data of development. In the first place, the relative character of the business done by the companies has changed but little during the past five years. The municipalities, however, if we omit Holyoke, have increased their power business more than twice as rapidly as have the companies, until at present their relative disposal of current corresponds very

[1] Cf. *Am. Hand. Elec. Eng.*, p. 1625. [2] *Ibid.*, p. 1626.

TABLE 19. RELATIVE AMOUNTS OF CURRENT DELIVERED

Percentage disposal of current	Companies		Municipalities		Percentage increase in the different kinds of business	1910–1915	
	1910	1915	1910	1915		Companies	Municipalities
Street lighting	13.2	14.3	35.1	24.3	Street lighting	32.2	(17.2)[2]
Commercial lighting	36.8	30.6	36.1	31.0	Commercial lighting	60.0	48.2 (61.9)[2]
Power	41.3	42.7	27.9	43.8	Power	74.0	168.3 (72.8)[2]
Sales to other companies	10.0	12.4	0.9	0.9	Sales to other companies	109.0	50.0 (3.32)[2]
Total	100.	100.	100.	100.	Total	68.2 (65.2)[1]	70.1 (58.0)

[1] Buzzard's Bay omitted. [2] Holyoke included.

closely to that of the latter, except in the items of street lighting and sales to other companies. The inclusion of Holyoke seems to make the development almost identical in the two groups for commercial lighting[1] and power. Otherwise, it is rather surprising to note that the private plants have increased the absolute amount of current sold *for all lighting purposes* far more rapidly than have the municipalities. These figures certainly refute the common statement that municipal plants do not get the power business. It is probably true, on the other hand, that these public plants are working largely for "paying" loads, while the companies are forced, by public pressure, to take on a good deal of poor business. It is a rather difficult matter to coerce a municipality. Yet it is not safe to make this conclusion absolute until the local conditions have been carefully studied.[2]

The quantity of current actually sold per kilowatt capacity of generators ("delivered" is a more accurate

[1] By "commercial" lighting is meant all lighting except street lighting. The returns for Massachusetts make no separation of what is sometimes termed "domestic" lighting.

[2] Cf. ch. XI, pp. 309–310.

expression so far as the public plants are concerned, since their street lighting is not on a commercial basis) averaged for each municipal plant 778 kilowatt hours in 1910 and 907 in 1915, and for the private plants 947 and 1,052 at the same dates. The gains were respectively 17.6 and 11.1 per cent. However, to secure figures which show the true conditions, purchased current should be deducted in either case, whereupon we find the averages to be 765 and 761 kilowatt hours for the municipalities, and 896 and 968 hours for the companies, — an absolute decrease of 0.5 per cent for the former and an increase of 8 per cent for the latter during the five-year period. The better showing made by the companies was probably due largely to a better load factor in 1910, as their power business was at that time much more highly developed, and in 1915 to the smaller losses of current as well as to a somewhat more favorable load factor.

The *per capita* consumption data are useful only in a rough sort of way, as showing the general tendencies in the two groups of plants. It is significant to note, however, that while the total number of kilowatt hours consumed *per capita* (sales to other companies being deducted) has increased somewhat more rapidly for the municipal plants than for the companies, from 48.4 to 72.2, or 49.2 per cent for the former, and from 52.9 to 74.9, or 41.5 per cent for the latter, the figures are remarkably close together. Evidently the municipalities were slightly behind in their development in 1910. But, in 1915, since the growth in number of inhabitants in the districts served has been almost identical in the two cases, 14.6 and 14.7 per cent respectively, we can with some assurance draw the conclusion that the population is being served about equally well in both groups, provided, of course, that the ratio of consumers to inhabitants is approximately the same. This we shall later find to be the case.[1]

[1] See p. 110, *infra*.

Upon analysis of the various classes of consumption, it appears that the *per capita* use of current for commercial lighting purposes has increased much more rapidly in the case of the companies, while the sale of current for power has increased much faster for the municipalities since this feature of their business was underdeveloped in 1910. Absolutely, the *per capita* consumption of current for commercial lighting is somewhat higher for the companies, 26.2 kilowatt hours as compared with 22.9 kilowatt hours, a difference of 14.4 per cent. This might be due to a number of local causes which it would be difficult to discover, even after a personal visit to the various localities. Perhaps it is the result of more advertising and pushing of business by the companies, particularly as regards the use of electric fans, irons, toasters, and other fixtures which are on the lighting circuits. Perhaps, also, as the *per capita* valuation of property is higher in the cities and towns served by the companies, there may be a proportionately larger number of wealthy residents in these places, who use more current for lighting purposes.

The power consumption is also 14.4 per cent more *per capita* for the companies (36.5 K.W.H.) than for the municipalities (31.9 K.W.H.) — a condition which we might naturally expect in larger population centers, and with more effort made to get new business on the part of the companies.

Finally, it is interesting to observe that the absolute *per capita* consumption of current for street lighting is about 50 per cent greater for the municipal plants (18.1 K.W.H.) than for the private plants (12.2 K.W.H.). Whether or not this means better public lighting in the case of the former, is a question which cannot be definitely answered, though no information secured in the local survey would warrant such a conclusion. Some aspects of this matter will be discussed later in the present chapter.[1] But it is a reasonably safe general assumption that municipali-

[1] Pp. 125–128.

ties owning their own plants would not feel the need of economizing so carefully in the use of the current which they themselves produce as would those whose streets are lighted by contract with private concerns.

4. Customers and Per Customer Analyses [1]

The total number of customers, eliminating double counting, has increased somewhat more rapidly in the group of companies than in the municipal plants, the rates being respectively 103 and 90.2 per cent. Due to this fact, the difference between the average number of customers per plant is greater in 1915 than in 1910. At the latter date the private plants averaged 29.5 per cent more customers than the public plants, whereas in 1910 the difference was only 21.5 per cent. The increase in the number of customers using current for light has been correspondingly greater for the companies. As the municipal plant returns in 1910 were not made out in such a way that the total number of power customers could be separated from the light customers, the year 1911 has been chosen instead for the study of this aspect of the business in both groups of plants. Between these dates, the increase in number of power customers was almost twice as rapid in the municipal plants — a growth largely accounted for by the fact that their power business was only partially developed in 1911. On the other hand, the more rapid increase in number of light customers in the case of the companies, suggests a rather strong probability that the municipalities may be avoiding this sort of business on the ground that much of it does not "pay." They are evidently conservative in their policy of extending service. The difference here found is doubtless in large measure the result of the discrimination made by the law regarding compulsory service by companies and by municipal plants. This aspect of the case will later merit further attention though there is some evidence

[1] Appendix, pp. 404–407.

which suggests that the public plants are at present serving a larger proportion of all possible customers than are the companies.[1]

Finally, the number of customers per 100 inhabitants of the district served has increased just 30 per cent faster in the companies than in the municipal plants, though the absolute figures are slightly less in the case of the former. The higher ratio shown by the latter (8.8 as compared with 8.2) is more than explained by the fact that, with only four exceptions, municipalities have not extended their service beyond their own boundaries. Furthermore, if the comparison be limited simply to the number of customers and inhabitants of the cities or towns in which the several plants are located, we find that the ratio becomes 8.4 per hundred for the companies, remaining practically the same as before for the municipalities. Since the density of population of the districts served by the private plants, even after all outside localities are eliminated, is much less than that of the municipalities owning their plants, we might naturally expect a much greater difference between these ratios. In conclusion, the public plants doing both a gas and electric business show a ratio of consumers to population somewhat under the average ratio for the group, while the corresponding companies apparently have a ratio considerably above the average. This fact probably indicates merely that the latter have pushed their electric business more actively than have the former.

In this connection it is interesting to attempt, from a different angle, a comparison of the proportion of population served in each case. This can be done in a rather crude fashion by finding the relation which exists between the total number of light customers and the number of assessed dwellings as returned to the Tax Commissioner. To be sure, this does not make allowance for the fact that many of these customers are stores, offices, halls, churches, etc.

[1] Cf. next page.

The errors thus arising, however, would probably be about the same for the two groups. Accordingly, taking only the number of dwellings in the municipalities in which the plants are located, and not including any of the customers, in outside districts, we find that the relations are as set forth in the following table: [1]

TABLE 20. RELATION BETWEEN ACTUAL AND POSSIBLE LIGHT CUSTOMERS (1915)

Character of plant	*No. of light customers* [4]	*No. of assessed dwellings* [4]	*Per cent of dwellings served*
I. Generating plants			
Municipal [1]	17,230	35,895	48.0
Company	19,923	48,201	41.5
II. Purchasing plants			
Municipal [2]	5,718	12,107	49.0
Company [3]	4,654	12,907	36.0

[1] Holyoke out.
[2] Norwood out.
[3] Franklin omitted because dwellings are not returned.
[4] Foreign districts excluded.

From the figures given it would appear that in both groups the municipal plants are serving a larger proportion of the possible customers than are the companies; and this advantage is particularly marked in the case of the purchasing plants, as we are led to expect from the analyses presently to be made. It must be borne in mind, however, that the public generating plants have by far the more compact territory, and the dwellings served are for the most part more closely grouped, as shown by the analyses of lines and streets with overhead lines as well as by the population statistics.[2]

The statistics of current consumption per customer, no

[1] The number of customers is found by deducting from the total number of light customers the number of customers of all kinds in foreign territory. The result is very nearly accurate, for probably few of those in outside districts are power customers.

[2] Pp. 130–131, 147 *infra*.

customer being counted twice, show the total average for both light and power to be 623.6 kilowatt hours for the municipalities, an increase of 5.5 per cent over the average amount in 1910. Upon inspection, however, it appears that 11 out of the 17 plants showed a decrease in this regard, and hence it is clear that the general trend was toward a less consumption of current per consumer. If Holyoke is included, the tendency becomes particularly marked, 16.8 per cent. The companies on the average show a definite decrease from 881 kilowatt hours in 1910 to 765 hours at the end of five years, or 13.2 per cent less. This decrease, as well as the increase for the public plants, was highly irregular. Evidently the companies have more large customers than the municipalities, since the absolute figures are greater. But owing to the nature of this particular average, it is hardly safe to draw definite conclusions.[1]

The quantity of current consumed per lighting customer decreased 22 per cent in the public plants during the five-year period, and almost 14 per cent in the companies. This decrease is probably in large measure the result of an increased utilization of Tungsten lights, which require far less electrical energy than the old carbon filament lamps. As the Tungstens seem to have been more widely used by the companies than by the municipalities in 1910, the decrease in their per customer consumption of current from this cause would be proportionately less, as indicated. The more rapid decrease in the number of arc lights used might also have had a slight effect in making the decline greater for the public plants. And, thirdly, it is certain

[1] It must be explained that the earlier total averages in this case are based on the returns of current sold in 1910. However, the average power consumed per customer is based on data given for 1911, due to the fact that, as noted above, the power customers could not in 1910 be separated from the total customers in the municipal plants. For this reason, and because there is no double counting of those customers using both light and power, the average consumption given will be by no means comparable with the individual items.

that both private and public plants have a larger proportion of small lighting customers than in 1910.

The higher absolute figures for the companies (327 kilowatt hours as contrasted with 264 kilowatt hours for the municipalities) are no doubt occasioned by a comparatively small number of *very large* customers — a condition which we might expect to find in the larger centers of population and in places where there are numerous hotels, etc. The inclusion of Holyoke, bringing the average up to 333 kilowatt hours, slightly higher than that of the companies, helps to confirm this point of view. Again, the companies have, as suggested above, probably pushed the use of those numerous fixtures which are ordinarily attached to lighting circuits much more energetically than have the other group. Thus, more current would *appear* to be used on the average by each lighting customer. The writer's reason for giving some weight to this argument is based on a study of the returns from the various plants, which show considerable sums spent for advertising, soliciting, and new business on the part of the private plants, and very little on this account spent by the municipalities. Previous analyses prevent the assumption in this connection that the companies are not developing the small lighting business.

It is rather interesting to find an identical rate of increase during the period in the average amount used for power per customer — a little over 24 per cent in each case. Nor is it surprising that the absolute figures are still somewhat higher for the companies (6782 K.W.H. *vs.* 6278 K.W.H.).

5. Connected Load and Per Connected Load Analyses[1]

Few of the records kept by electric lighting plants are less satisfactory than the connected load data, though, *for rate-making purposes, few are more significant.* From the very nature of the business it could not well be otherwise,

[1] Appendix, pp. 408–415.

for, even with the most skillful management and careful engineering, it is practically impossible to keep track of the constant changes which take place in the various kinds of business. Obviously the power load can be much more nearly approximated than the lighting load. Yet, if reasonably careful estimates have been made, the average connected loads for two fairly large groups of plants, provided we can get them, should be of some general use in our comparative study. Unfortunately nearly 50 per cent of the municipal plants have not seen fit to give complete data on this point, though all of the companies have returned the information required by the Board. As so small a proportion of the former have made this return, the figures submitted by the remaining ones are probably open to even more question than the figures of the companies.

However that may be, we have the total connected load of 9 municipal plants, Holyoke excluded, to compare with that of the 17 private plants. While the lighting load data are totally lacking in so many cases, with one or two exceptions the municipalities have returned some kind of a connected load for power, and the street lighting data seem to be complete. Aside from carelessness in estimating, the figures are frequently wrongly reported, as, for example, when the horse power of motors is returned as if it were kilowatts, and when an incorrect wattage is given for lamps even though the number may be correct. Some of these inaccuracies can be found and rectified, while others cannot. Whenever possible the writer has checked the returns of preceding or following years. Thus, it has often been possible to correct rather serious errors which have escaped the attention of the Board's accountants. Finally, as no definite connected load data were worked out by the municipal plants before 1911, in order to reduce the inaccuracies to a minimum that year instead of 1910 has usually been selected for comparison with 1915. No connected load occasioned by service to other companies

is included. Bearing in mind these cautions and restrictions, we are in a position to make a few analyses of the connected load figures.[1]

It is necessary, however, to know something about the physical character of the connected load, the kind of lamps, size of motors, etc., and to study the changes which have been taking place, before we can intelligently discuss the load itself. We find the commercial lamp data of the public plants so unsatisfactory that they hardly merit study. Though all of them attempted to give the number of lamps in 1910, only 10 did so in 1915. Excluding Holyoke, the 9 plants reporting at both dates show an increase of 53.3 per cent during the five-year period, while the companies report twice as great an increase, or 103.8 per cent. If Holyoke be included, the first group has an increase of 121 per cent instead of 53.3. No doubt many of the public plants have greatly underestimated their commercial lamps, for several report practically no increase during the period, though their customers have almost doubled in number. Hence, we find in this group an actual decrease in the number of lamps per customer from 22.2 to 19.3, or 13.1 per cent. This is a *possibility*, but scarcely a *probability* in view of the lower cost of lamps in 1915. The companies, on the contrary, absolutely higher in the beginning, show an increase of 2.9 per cent, from 24.4 to 25.1 lamps per customer. When Holyoke is included, the proportions become nearly equal. In the *per capita* statistics, though both groups were close together in 1910, the municipalities were somewhat ahead at the end of the period (2.22 to 1.9) having gained 91 per cent as opposed to a 72.7 per cent gain for the companies. This difference can be readily understood when we remember the wider area served by the latter.

[1] As the Board specially requested the total load data in kilowatts from the municipal plants in 1911, there is a strong presumption that more care may have been exercised in getting this information then than at any other date.

The commercial *arc* lamp data are probably correct in both cases, as it is not difficult to keep track of them. It appears that the 9 municipalities giving full reports in 1915 had only 20 commercial arcs, a decrease of 60 per cent from the number, 49, in 1910, and, for *all* of this group excluding Holyoke, the number dropped from 223 to 29. Holyoke reported about 70 per cent of the total number in 1910 and 85 per cent in 1915. The companies returned 667 arcs at the former date and 201 at the latter, a decrease of 70 per cent. So far as the incandescent lamps are concerned, little can be made out of the records regarding carbons and tungstens, except that the definitely specified proportion of the latter is much higher in the company plants.

A study of the connected power load reveals the fact that the number of motors has increased much more rapidly in the public plants, 153 per cent during five years. The companies reporting at both dates show an increase of only 52 per cent. All but one of the first group did a power business at both dates. In two of the companies the number of motors could not be ascertained either in 1910 or in 1911, while in two other cases there was no motor service. Only one did not supply power in 1915. The average capacity of motors has been computed for the year 1911 instead of 1910, as the returns at this date seem more trustworthy. When sufficient data could not be secured for this year, the preceding one was chosen. It appears, therefore, that the average kilowatt capacity of motors was higher at both dates for the municipal plants (5.18 and 6.47 K.W. as contrasted with 4.34 and 5.95 K.W. for the companies). Though the rate of increase has been 50 per cent more rapid in the case of the private plants (37 *vs.* 25 per cent), yet the average capacity is still 9 per cent greater for the municipalities. This difference might be in some measure due to the fact that the latter have sometimes reported horse power for kilowatts or have

failed to return the correct number of motors, as seemed to be the case with respect to their commercial lamps. Some weight may also be given to the argument that throughout the period the companies have been consciously attracting the smaller customers. And, finally, it is probably in large measure the result of differences in local conditions, for the municipalities owning their plants are, in proportion to population, the greater manufacturing centers. In the municipal group the large plants of Taunton, Chicopee, Peabody, and Danvers seem to be for the most part responsible for the higher average capacity of motors. Of the companies, on the other hand, Amesbury, Plymouth, and Quincy also have a large number of motors of more than average size.[1]

The rate of increase in the total connected load of the municipal plants reporting, 57.4 per cent, or 66.6 per cent including Holyoke, is practically the same as that in the companies, 63.8 per cent. These rates coincide closely with the rate of increase in the amount of current sold for all purposes in the two groups, 70.1 and 68.2 per cent respectively. The wider spread in the case of the municipal plants between the rate of increase of connected load and the rate of increase in current delivered, in spite of the fact that they sell a very small quantity of current to other companies, is occasioned partially by the fact that the character of their load, much worse in 1911, has been improving more rapidly than that of the companies. The figures are further influenced by the fact that only 9 out of 17 public plants are represented, and these among the smaller ones. It is also probable that in many cases not all of the load was reported, and that the little consumers with large loads have not been encouraged by the municipalities. On the other hand, the private plants, because of the important commercial considerations involved,

[1] A discussion of the street lighting data will be reserved till the connected load has been studied in its varied aspects.

would probably overestimate rather than underestimate their connected load. Holyoke, the most efficient of the municipal plants, shows an increase in connected load considerably more rapid than the increase in amount of business.

The connected load of the companies averages 80.4 per cent greater than the average generating capacity per plant, while that of the 9 municipalities averages 93.2 per cent greater. The higher ratio of the latter, since the proportionate amount of current bought is about the same in either case, may be accounted for in some measure by the fact that the public plants still have the larger proportion of inactive load. It is also even more probable that they are not anticipating future needs by enlarging their generating capacity, to the extent that the companies are doing so.[1] The difference between the two ratios, however, not much over 16 per cent, is not in itself very significant.

In the 7 public plants which furnish sufficient data for computation, the ratio of the maximum station load to the connected load is 29.4 per cent, and, by a surprising coincidence, the ratio of the 14 companies is also 29.4 per cent. Expressed in better terms, the total connected load in both cases is 3.4 times the total maximum load upon the stations. This would seem to indicate a similar "potential" diversity factor for the two groups, if we may coin a new expression. These figures furnish us no clue, however, to the true *diversity factor, which is the ratio of the maximum demand of the system upon the station to the sum of the separate or individual maxima.* If allowance is made for the fact that a considerable portion of the companies' maximum demand, probably not less than 10 per cent, is occasioned by sales to other companies or to municipalities, whereas this influence is practically *nil* in the case of the municipal plants, we can readily see that the "potential" diversity factor would be by so much the greater for the public

[1] Cf. pp. 303–304, *supra.*

plants, since the connected load data do not include these foreign loads. On these grounds it would probably be safe to assume that the companies really have a more favorable diversity factor than the public plants, in so far as their individual customers are concerned. The writer feels that this deduction is reasonably correct, though because of the lack of more adequate data, the comparison attempted is interesting rather than conclusive.

Upon examination it appears that the proportionate distribution of the total connected load among the various classes of service, commercial lighting, street lighting, and power, is practically the same in the two groups. The public plants are a very little in the lead for both of the lighting loads, while the private plants have a slightly higher percentage of power load. In both cases, however, the power load is close to 50 per cent of the combined light loads. The very noticeable difference between the municipal power load of the public plants and that of the private plants, an average of 20.26 kilowatts per plant in the former and of only 6.47 in the latter, is for the most part accounted for by the fact that a number of the municipalities operate pumping stations or sewage disposal plants in connection with their electric light stations. Also it is but natural that localities serving themselves should be generous with that service.

During the past four years there has been almost no change in the percentage distribution of the various connected loads of the companies, excepting a small decrease in the lighting loads. The municipalities, on the contrary, have been subject to a very marked percentage decrease (from 79 to 64.6 per cent) in the commercial lighting load, and the absolute increase has been comparatively slight, only 28.6 per cent as contrasted with 61.9 per cent for the companies. Their gain has been largely in the power load, which has increased absolutely 179.4 per cent, so that its proportion of the entire load has doubled in four years,

now standing at 32.3 per cent whereas it was only 16.1 per cent of the total in 1911.

The rate of increase in the power and commercial lighting loads of the companies corresponds with remarkable closeness to the rate of increase in the current sold for these purposes — 61.9 to 60 per cent for lighting and 74.3 to 74 per cent for power. For the public plants the rate of increase of the power load roughly approximates the rate of increase of current delivered to power consumers (179.4 to 168.3). But there is not the same close connection in the case of the commercial lighting loads and sales of current for lighting. The increase in commercial lighting sales (48.2 per cent) seems to have been much more rapid in the municipal plants than the increase in lighting load (28.6 per cent). While this *might* mean an improvement in the already existing lighting load, it probably signifies that the estimate of the number of lamps connected is too low. Holyoke shows a closely parallel increase in both items. The absolute increase in the street lighting loads, which are probably as accurate as could be wished for, has been negligible in both cases, though slightly more rapid for the companies. Hence the absolute increase in the amount of current delivered for street lights and the relatively greater increase in the case of the companies, are occasioned by longer hours' use of lamps per night and by a larger number of nights' use per month. Finally, in all of these comparisons we must bear in mind the fact that we are contrasting the increase in connected load since 1911 with the increase in current sold or delivered since 1910.

Owing to the unsatisfactory character of both the population and the connected load data, it is scarcely worth while to deduce any relations between the two. In passing, however, it may be noted that the increase of the *per capita* connected load has been somewhat more rapid for the companies (from 103 to 147 watts, or 52.7 per cent)

than for the municipalities (from 129 to 169 watts, or 31 per cent). This may show an increasing effort to develop the territory served by the companies; while the higher absolute figures for the municipalities are probably a result of the more restricted area served and the denser population.

The aggregate light and power connected load per customer seems to have increased very slightly, from 1.36 to 1.40 kilowatts, or 3 per cent, in the group of 9 municipal plants, and to have decreased an inconsiderable amount, from 1.83 to 1.75 kilowatts, or 4.4 per cent, in the other group.[1] The average lighting load of the former, 0.950 kilowatts, is 17.4 per cent less than in 1911, while that of the private plants has decreased only 6.6 per cent to 1.13 kilowatts. This difference in rate of decrease corresponds roughly to the rate of decrease in the amount of current consumed per customer for lighting purposes. The fact that the absolute figures are higher for the companies and that their rate of decrease has been less, should be interpreted in the light of what has already been said regarding the total load data and the consumption of lighting current per customer. If the number of lamps reported by the municipalities is too low, as is probable, the connected lighting load per customer would naturally appear less than it should be.

The average power load per customer, as might be expected, has almost doubled in the 14 municipal plants reporting at both dates, and has increased only 25.5 per cent in the companies, so that the absolute figures are now very close together, 9.46 (9.22) kilowatts for the former, and 9.74

[1] In the averages computed in this connection, the municipal power load is included, since it is impossible in most cases to separate this item from the total power load in 1911. In 1915 the municipal power load of the public plants amounted to only 3.7 per cent of the total power load, and to less than 2 per cent of the total light and power load. In the companies the percentage of municipal power load reported is so small as to be negligible. Hence the averages will be little affected by this inclusion.

for the latter. The rate of increase for the private plants coincides with the rate of increase in current consumed per power customer (24 per cent), and we can probably assume that the company returns are reasonably accurate in this connection. On the other hand, the fact that the public plants show an increase of only 24.1 per cent in the consumption of current per power customer and 95.1 per cent increase in each power customer's connected load, is, to say the least, rather puzzling. Even when we eliminate the large plants of Danvers and Westfield, which show an abnormally large increase in this particular, the rate still does not fall below 70 per cent.

This discrepancy cannot be accounted for by any unusual increase in connected power load late in the year 1914–15. It may mean that some of the public plants are still reporting their power load in horse power as they formerly did, instead of in kilowatts as called for in the returns. This would make their reported load considerably higher than the actual load, since a horse power is only three fourths of a kilowatt. As the writer has discovered and corrected a number of such cases, it is probable that there are others. Yet, as we shall find the current consumed per kilowatt connected power load almost identical in the two groups, this assumption does not seem exactly to fit the case, for, if the kilowatts be reduced to horse power, it would tend to make the consumption per kilowatt hour considerably higher for the public plants. This would indicate a large number of power customers with very favorable loads, and it would not make allowance for the fact that the companies also might have reported wrongly. On the other hand, if we assume that the returns are approximately correct on this point, it evidently means that the public plants, with so rapid an increase in connected power load, must have taken on a large proportion of small power customers. However, since the average size of the connected motors is greater in the case of the

municipal plants, this view of the matter can hardly be accurate. Nor does it seem probable that those customers occasioning a marked increase in the load would consume a relatively small quantity of current.

Knowing that the consumption of current per power customer has increased at an equal rate for both groups of plants and that the consumption per kilowatt connected load seems to have decreased at about the same rate in both cases, we will not attempt further to discover why the rate of increase in connected power load per customer in the municipal plants is four times as great as that of the companies, and four times as great as the rate of increase of current used per power customer in either case. It is also reassuring to know that Holyoke, the paragon of public plants in the State, shows only a slight increase in connected load per power customer.

Having deducted the sales to other companies, we find that the yearly consumption of current per kilowatt connected load has decreased 10.8 per cent (from 573 to 511 K.W.H.) for the companies since 1911. For the municipalities there is an apparent increase of 18.5 per cent (from 443 to 525 K.W.H.). This decrease on the part of the former is probably accounted for by the fact that their service has been extended more rapidly to the poorer customers. But, if Holyoke be included with the public plants, the decrease is about the same in the two groups.

Upon analysis of the different classes of business, it appears that the amount of current consumed per kilowatt connected lighting load in the company plants has decreased 5.6 per cent during the period, whereas there has been an increase of 10 per cent in the municipalities, so that the relative amounts consumed are now respectively 289 and 252 kilowatt hours. For reasons which are fairly obvious from what has already been said, we would expect the higher absolute figures in the case of the companies. The effect of seaside resorts on the use of maximum demand

can be clearly seen. Though the increase of this item for the public plants *might* indicate that their business is being rapidly pushed, it is probably due still more to the fact that unsatisfactory customers are discouraged by the provision in the law to the effect that the cost of extensions and connections on the customer's property can be assessed wholly or in part upon him as well as by the fact that no *city* or *town* can be compelled to furnish electricity without an express order of the Board of Gas and Electric Light Commissioners.[1] There will be occasion later to revert to this aspect of the case. Finally, the failure to report a sufficient number of lamps would also make the increase appear greater.

There is a close correspondence between the increase in the number of kilowatt hours consumed per street lighting load in the two cases, 10 per cent for the municipalities and 12.3 per cent for the companies. This simply means that the lamps are being used a greater number of hours per year than formerly. The power consumption, per connected load, on the other hand, has decreased in both groups, but with greater rapidity in the municipalities. The figures are now close together, being 699 kilowatt hours for the companies and 674 for the public plants. This decrease doubtless signifies that new uses for power have been found, while the seemingly more rapid decrease in the municipal plants, which were slightly in the lead in 1911, may or may not be the result of inaccuracy in reporting the connected load.

Table 21 presents in a convenient form some comparisons between the connected load and the consumption of current in the two groups of plants. As we have found the number of kilowatt hours' consumption per kilowatt connected load for the various classes of service, and since the maximum use would necessarily be 8,760 hours, the number of hours in a year, it is a comparatively simple matter

[1] Mass. 1914, ch. 742, sects. 117, 118.

TABLE 21. UTILIZATION OF MAXIMUM DEMAND

Connected load	*K.W.H. Consumed per K.W. connected load*		*Number of days' use per year*		*Number of hours' use per day*		*Per cent of possible use*	
	Companies	*Municipalities*	*Companies*	*Municipalities*	*Companies*	*Municipalities*	*Companies*	*Municipalities*
Total.....	511	525	21.2	21.9	1.39	1.44	5.8	6.0
Commercial lighting ...	289	252	12.0	10.5	0.80	0.70	3.3	2.9
Power.....	699	674	29.1	28.0	1.90	1.80	8.0	7.7
Street lighting.....	3437	3783	143.2	157.6	9.40	10.40	39.2	43.2

to find the number of days' use of the maximum demand, the number of hours' use per day, and the ratio which the actual use bears to the *possible* use. As the connected load used is that found at the end of the year, and not the *average* for the year, the "use" factor in each case will be somewhat too small. The remarkably close coincidence between the two sets of plants would lead us to infer that the local conditions are similar. But full allowance must be made for the numerous possibilities of error already mentioned.

6. STREET LIGHTING DATA AND ANALYSES [1]

Before leaving the subject of connected load, attention must be paid to the character and development of the street lighting load, which, for our purposes, stands in a class by itself, since this is the portion of the business of municipal plants that is not carried on as a commercial undertaking. The data in this case are fairly trustworthy, for the returns call for great accuracy. As the street lamps of other municipalities supplied by the public plants constitute only 5.5 per cent of the total for this group, they have been omitted in the computations so that we can better study the conditions of street lighting in the cities and towns which have their own lighting plants. These foreign street lights are really a part of their commercial

[1] Appendix, pp. 416–419.

lighting business. When there is a possibility that their inclusion would have a noticeable effect upon the averages, mention will be made of the fact.

The percentage of arc lights was higher at both dates for the companies, and the decrease in numbers has been just twice as rapid in the municipal plants. At present the arcs are equal to 7.9 per cent of the total number of street lamps in the latter group (11 per cent if Holyoke be included) and 10.6 per cent of the total in the former. There does not seem to be any marked difference in the kind of arcs used in the two cases. Of the incandescent lamps the carbons amounted to 28 per cent of the total for municipal plants in 1910 and to 5 per cent in 1915. For the companies, however, the carbons formed only 18 per cent of all incandescents at the earlier date, and in 1915 less than 1 per cent.

The increase in the total number of street lights has been far more rapid for the companies than for the municipalities. Though five years ago the number of lamps per plant was 25 per cent higher in the public plants, the figures are now approximately the same. This means that, as the average population of the districts served is greater in the former group, the number of lamps *per capita* will be somewhat less. Yet the companies have extended their service continuously until one lamp now serves 24.8 persons, while in the other group there is one lamp to 18.1 inhabitants. Obviously the more scattering population of the former, as well as the somewhat greater number of arc lights will help to account for the difference, in spite of the fact that the average wattage of lamps is now equal. Also, it is to be expected that municipalities would keep themselves generously supplied with lights, the real cost of which is not disclosed by the accounts kept, and which in some cases may be partially paid for out of the profits made in the commercial lighting business.

The number of feet of street lines per lamp is 511 in the municipal plants and 617 in the companies, though the

length per commercial customer is about the same (329 and 303 feet respectively). The greater length of "overhead" per lamp in the latter (436 *vs.* 299) is accounted for largely by the fact that they serve a more sparsely settled territory, of which more anon. There is one lamp to 1.6 commercial customers in the public plants and to 2.1 customers in the other group. Probably geographical conditions go far to explain the difference, as well as the fact that the companies are located for the most part in places which are residential rather than manufacturing. After a tedious computation it appears that the "rated" candle power of illumination *per capita* has decreased at an equal rate in both groups, now standing at 8 candle power for the public plants (or only 7 candle power if Holyoke be included), and 6.4 for the private plants.[1] This decrease in *per capita* candle power is doubtless largely accounted for by the increased use of smaller lamps more effectively placed than formerly. As might be expected, due to the advance in the art of lighting, the decrease in the *per capita* wattage of lamps has been more rapid than the decrease in candle power — a fact which shows the increasing lamp efficiency. This decrease in wattage has been more marked in the case of the companies. Though the differences in all of these relations are surprisingly constant, we are scarcely justified in attempting to draw definite conclusions therefrom.

[1] It is an almost hopeless task to endeavor to discover the real candle power of the street lights. The municipalities have usually reported the supposed candle power of certain classes of lamps, and their estimates have, with interpretation, been accepted by the writer. Then, in computing the candle power for the companies, which make no return of these data, the same kind of lamps are assumed to have the same candle power as in the municipal plants. Hence any errors will be about evenly distributed between the two groups. Needless to say, the real candle power depends upon a number of conditions which it is, under the circumstances, impossible for us to evaluate. So far as the incandescents are concerned, the figures are a close approximation; but arc lamps are probably much overrated. It is, therefore, safe to say that the *per capita* candle power here given is somewhat too high.

In which of these groups of plants the inhabitants are the better served by their street lights could probably be decided only after a period of residence in each locality. It may be that, as a result of more skillful engineering, the companies are really serving the people more adequately with fewer lamps. And it may very probably be true that in the closely populated portion of the cities and towns the *per capita* service is identical. This supposition could be verified only by finding the relations between the number of inhabitants, extent of territory, and number of street lamps, in the business and residential sections of the places under consideration. And, furthermore, condition and width of streets, color of pavements and sidewalks, arrangement, height and color of buildings, amount of foliage, local topography, and character of the business engaged in, all play an important part in determining the needful number of street lights, even if we grant that the engineering skill is the same in either group of plants. However, the local survey made has convinced the writer that the companies, by virtue of their contracts, are forced to give far more careful attention to the problem of street lighting, than do the public plants.

Waiving the engineering aspects of the case, the records are for the most part definite regarding the quantity of service rendered by the street lamps in both groups. The *average daily* number of lamps in use, as would be expected, varies little from the *actual* number. The average number of nights' use per month is practically the same in both cases, being 30 nights for the municipalities and 29.7 for the companies. The increase has naturally been more rapid for the latter as they showed a relatively lower figure five years earlier. However, numerically weighted, the average number of hours' use of lamps per night is considerably lower for the companies (7.8 hours) than for the municipalities (9.1 hours), though the rate of increase during the period has been much more rapid for the former

(16.9 per cent) than for the latter (5.8 per cent).[1] If we should eliminate from the companies the lights which are operated in foreign localities, constituting about one eighth of the total and burning for the most part on short schedules, their average number of hours' use per night would be somewhat increased.

But it would be foreign to our purposes to discuss at greater length the more technical aspects of the problem. The accompanying table (Table 22) sums up some interesting computations regarding the street lamps in the two groups of plants (Holyoke being excluded).

TABLE 22. STREET LIGHTING DATA (GENERATING PLANTS, 1915)

	Companies	*Municipalities*
Total number of lamps	11,511	11,621
(Lamps in other places)	(1,407)	(633)
Total number of lamps actually in use	10,783	11,341
(Lamps in other places)	(1,281)	(614)
Average wattage of lamps	88	87
Average C.P. of lamps	170 (?)	147 (?)
Per capita wattage	3.6	4.7
Per capita C.P.	6.4	8.0
Current consumed per lamp (K.W.H.)	324.0	313.0
Current consumed *per capita* (K.W.H.)	12.2	18.1
Number of nights in use per month	29.7	30.0
Number of hours in use per night	7.6	9.1
Number of inhabitants served by one lamp	24.8	18.1
Number of commercial customers to one lamp	2.1	1.6
Length of street lines *per capita* (ft.)	25	29
Length of street lines per lamp (ft.)	617	511
Length of street lines per customer	303	329
Length of streets with overhead lines (commercial and street)[1] per lamp	436	299

[1] Commercial and street lighting cannot be separated.

[1] The lack of correspondence between the average number of hours' use per night, as here computed from the annual returns of the various plants, and the number of hours' daily use of the connected street lighting load, as computed in the preceding table (10.4 hours for the public plants and 9.4 for the other group), must not mislead the reader. This considerable difference, amounting to 1.3 hours for the former and 1.8 hours for the latter, can be accounted for in several ways. First, in the present calculation the lamps are not weighted according to their wattage, but according to their number. As most of the higher wattage

7. Lines, Poles, and Transformers[1]

The companies in 1910 served only 14 foreign localities, while by 1915 they had extended their service to 7 additional places. Likewise the municipalities extended their service to 4 other municipalities during the same period. Yet, even if from the list of companies we omit Buzzard's Bay, which was just beginning operation at the earlier date, and which has since then taken 4 other towns into its district served, we still find that the increase shown by the latter in length of lines and number of poles is astonishingly greater than that of the former. Even more striking is the rate of increase of streets with overhead lines in the case of the companies.

The commercial lines for both light and power service — and they are usually not separated, as practically no direct current is used — compose 69 per cent of the total in the companies and 62 per cent in the municipalities.[2] The total increase of lines during the period was for the former 87.3 per cent (73 if Buzzard's Bay be omitted), and for the latter 60 per cent. In the separate classes of service, the increase in length of commercial lines was 115.2 per cent for the companies and only 76.4 per cent for the municipalities, in spite of the fact that even at the earlier date their commercial lines per customer were 11 per cent

lamps were in operation for the longer interval, this would be almost sufficient to account for the difference. Again, there are certain losses between the place where the current is metered and the lamp terminal, which, since they could not be eliminated in computing the table, would make the kilowatt hours' consumption per kilowatt connected load somewhat higher than in reality it is. This, in turn, would make the number of hours' use per day too high. Finally, there are doubtless numerous errors in the returns regarding the number of hours' use of lamps per night, and we know nothing definite about the "outages."

[1] Appendix, pp. 420–422.

[2] Needless to say the line data are probably far from accurate in both groups of plants, doubtless being less accurate for the municipalities; but there is no reason for supposing that the group averages will fail to show the true relations between the two.

longer than those of the public plants. The street lighting lines, also, have increased 47.4 and 38.7 per cent respectively. Omitting Buzzard's Bay, we find that the rate of increase of street lines has been practically the same in both cases, while that for the commercial lines is still more than 25 per cent ahead of the company rate. But there seems to be no good reason for leaving out this plant, for it merely presents a case of unusually rapid growth from small beginnings.

The length of streets with overhead lines has increased almost twice as rapidly for the companies, 65.3 per cent as opposed to 37.4 per cent in the public plants. Also it appears that there are 4.6 miles of line to one mile of overhead in the companies, and 4.1 to each mile in the public plants. In 1910 the ratios were respectively 4 and 3.6. These and the foregoing data serve to show that the companies have not only been extending their facilities far more liberally than have the other group, but also that they have probably developed their territory somewhat better.

This development becomes still more clear when we compare the relations between length of lines, number of customers, and inhabitants of districts served. So far as the street lines are concerned, there has been a considerable *per capita* growth in both cases, but more marked for the municipalities. Absolutely, the latter are still in the lead, with 29 feet *per capita* as compared with 24 feet in the companies. Evidently the public plants have been developing their street lighting with greater zeal than their commercial business.

It is, however, the commercial lines that most concern us, and here we find that the length per customer has decreased 7.3 per cent for the municipalities, and has increased 6 per cent for the other group, or has remained almost stationary if Buzzard's Bay be omitted. Accordingly, the length of lines per customer is 26.5 per cent

greater in the companies (678 feet) than in the public plants (536 feet, or 471 including Holyoke). In other words, the number of customers per mile of line has been increasing for the latter group, from 9.13 to 9.85, or 7.9 per cent, and decreasing for the former, from 8.25 to 7.80, or 5.5 per cent. Had we no other data at our command, these figures might seem to make a bad showing for the companies, since they would appear to indicate that the territory served is not being so well developed. But, when we know that the area served by them is much greater, that their lines have been extended more rapidly, and that the rate of increase of their customers has also been faster than in the other group, it becomes evident that such is not the case. In fact, the opposite would seem to be true. Yet the condition indicates that there has been a much larger investment in lines per customer in the companies, which, other things being equal, would be reflected in higher charges for service. This aspect of the subject will be dealt with in the following chapter.

Again, it is instructive, though not conclusive, to note that the number of inhabitants per mile of overhead lines (both commercial and street) has decreased only 17.6 per cent for the municipalities, from 322 to 267, while the decrease for the other group has been from 433 to 301, or 30.5 per cent. Also, the number of customers per mile of overhead is 24.8 in the public plants and 24.7 in the companies. The first set of figures indicates an extension of lines more rapid than the growth of population, particularly on the part of the private plants, which are now evidently as well equipped to serve their far more extensive territory as are the municipal plants. The small *per capita* advantage in favor of the latter is to be expected in view of the more restricted area served.

It may be argued by some that the greater relative length of lines in the companies is due to the fact that they have failed to write off their "dead" wire. The data studied for

only *one* year might seem to confirm this supposition. But, having found so marked a growth during the five-year period, both in lines and in streets with overhead lines, the writer puts little credence in this theory. The facts, so far as discoverable, all refute this contention.

Finally, before leaving the subject of lines, attention must be directed to another striking development found in the companies and not met with in the municipal plants, namely, the increasing utilization of underground construction. In 1910 our group of private plants returned a total of 3.5 miles of conduits, with 4.2 miles of cable, which in 1915 had increased to 21.1 miles of conduit, with 123.3 miles of cable therein. By far the greater portion of this underground construction is accounted for by the two companies of Beverly and Gloucester. The municipal return forms do not even provide a place for recording the length of conduits, and, so far as the writer is informed, none of these plants, with the exception of Holyoke, which boasts several thousand feet, have any underground construction whatever. Owing to the high cost of such construction we would naturally expect an investment in lines relatively much greater for the companies.

We find the same interesting development in the number of poles, the increase for the companies being 76.2 per cent and for the public plants only 28.7 per cent, commensurate with their increase in overhead. If Buzzard's Bay be deducted, the former increase becomes 61.6 per cent. Furthermore, there are a few poles "jointly owned" reported by the private plants and a few "rights of attaching," which are customarily charged against the capital account and may in a very literal sense be regarded as part of their property. Even when all of these are deducted, we still find that the increase in number is more than twice as rapid for the companies as for the municipalities. At present twice as many poles per plant are owned by the former as by the latter. Also, the reported number of poles

per mile of line is found to be 10.4 for the private plants and 7.8 for the others, while the number of poles per mile of overhead is 47.5 and 35 respectively.[1]

What is the meaning of this marked discrepancy? It is, to be sure, partially a result of the more conservative extension policy of the public plants. However, it is more largely accounted for by the fact that they are attaching their wires to every support available, to telephone and telegraph poles, to street railway poles, and to trees, — and, by the way, the latter fact may account in some measure for their greater loss of current in distribution. While three companies report a comparatively small number of jointly owned poles, and two plead guilty of using a few hitches on trees, 13 out of 17 municipalities report the use of foreign poles, not to mention trees. Of this number, 5 give definite figures, and 8 simply state that they use foreign supports whenever possible or that they do not know the number. And, furthermore, they neither pay rental for the privilege of attaching, with the one exception of Concord, nor, so far as the writer can discover, have they ever entered any charge against their capital account. It is pure gain for the municipalities, resulting from the provisions of the franchises which they have granted. In a test case the Supreme Court of the State has upheld the practice as being within the "police power" of the municipalities.[2] But, while they can secure this free service *ad libitum* and so save a large capital investment, they are at perfect liberty to rent their own poles, and four of them report a goodly income from this source during the year. On the other hand, while the mayor and aldermen or the

[1] The returns are probably inaccurate on this point, in many cases, and it may be that some of the companies have claimed as their own, poles which do not really belong to them. There is, however, not much reason for thinking the errors are greater for the private plants than for the public.

[2] Postal Telegraph Cable Company of Massachusetts *vs.* City of Chicopee, 207 Mass. 341. Cf. also Mass. R.L., XXV: 52.

selectmen may grant a private concern the privilege of attaching wires to the poles of other private concerns or to the municipal poles, it is understood that a reasonable compensation shall be paid therefor.[1]

Finally, the rate of increase in number of line transformers has been practically the same for both, 44.8 per cent in the public plants and 41.2 per cent in the companies, while the number of customers per transformer is also the same, 6.4 and 6.3 respectively, — a condition which obviously may suggest similar line engineering. Aside from the mere mention of the fact that practically all of the service is now metered, even the contract service, it is not worth while to study the subject of meters, which may or may not coincide with the number of customers. (On the subject of transformers the reader is referred to the above discussion of current unaccounted for.)

8. Physical Statistics of Purchasing Plants[2]

The more important physical features of our group of purchasing plants will be reviewed but briefly, since, for reasons which have already been considered, it does not seem worth our while to attempt any comparisons with the year 1910. So far as the output of current is concerned, practically the same relations are found in this group as in the group of generating plants. The companies purchase on the average 266,715 kilowatt hours, about 70 per cent more than the average public plant (157,173 K.W.H.). Norwood is omitted from the general comparison for the same reason that Holyoke was omitted from the other group. No load factor analysis has been attempted because, as has previously been stated, the municipal plants, with only two or three exceptions, return no data which would enable the computation to be made. For the 8 companies which give some meager information regarding

[1] Mass. R. L., xxv: 52; and 1911, ch. 509, sect. 2. See ch. xi, p. 306.
[2] Appendix, pp. 460–465.

their peak load, it appears that the average load factor is probably about 20. It will naturally run somewhat lower for the municipal plants, as their power business is proportionally smaller.

In the matter of distribution efficiency the public plants have some advantage, inasmuch as their current used at station and unaccounted for is only 22.7 per cent of the total output, while that of the companies is 24.5 or proportionately 8 per cent higher. This, however, is not in itself a very significant difference, and can probably be largely accounted for by the fact that the public plants have in general a much newer distributing system.

Upon an examination of the average size of transformers and the distribution of the different sizes, it appears that the municipal plants have an average of only 3 K.W., which is far below the companies' average of 5.60 K.W. Also, slightly more than half of the transformers of the former (51.9 per cent) are of the 1 K.W. size or under, while less than one fourth (22.5 per cent) of the total number of the latter are so small. The table shows these relations:

TABLE 23. TRANSFORMER DATA (PURCHASING PLANTS, 1915)

Class of plant	*Average size (K.W.)*	*Percentage distribution of the different sizes of line transformers*				
		1 K.W. or less	*1+ to 3 K.W.*	*3+ to 5 K.W.*	*5+ to 10 K.W.*	*Over 10 K.W.*
Municipal.....	3.00	51.9	24.1	12.2	7.3	4.3
Company.....	5.60	22.5	28.4	24.0	14.0	11.3

Other things being equal, we would accordingly expect to find a considerably smaller amount of current unaccounted for in the companies. But it must be remembered that, inasmuch as these plants are much older than the other group, their transformers may be in many cases antiquated.

As might be expected under the circumstances, the private plants have a marked advantage in the extent of their power business. They sell more than twice as great a percentage for this purpose (31.3 per cent of the total sales) as do the other group (13.9 per cent). It is absolutely certain, however, that the municipal returns are hopelessly inaccurate on this point. Four report power customers and no motors, one reports customers and no sales, and one (Shrewsbury) returns 60 customers, 60 motors, and sales to the extent of 2,113 kilowatt hours! With the exception of the Norwood plant, which is in a manufacturing center, and Wellesley, which sells a considerable quantity of current to its water department, most of the public plants seem to have a comparatively small opportunity to develop a good power business. The chief function of the majority of this group seems to be to light the streets and supply the residences.

It is somewhat surprising to find that the number of kilowatt hours supplied *per capita* is 36.8 in the companies and 45.5, or 24 per cent higher, in the municipal plants. This is an unusually good showing for the latter, since the density of population in the territory served by them (136.7 per square mile) is conspicuously less than that of the territory served by the other group (218.2). There seems to be no denying the fact that they have developed their trade in a remarkable manner, considering how recently they have entered the field. It is also interesting to note that the *per capita* consumption of current for street lighting is nearly twice as great in the public plants (14.2 K.W.H.) as in the private plants (7.8 K.W.H.), while their *per capita* power sales (6.3 K.W.H.) are little more than half those of the latter. But, as intimated, these last figures are probably somewhat too low for the municipal plants.

Though the companies do a two thirds larger business than the other group, they have only 30 per cent more

customers (376 as compared with 289). This of course suggests larger sales per customer, which we find to be 410 kilowatt hours, or about 50 per cent higher than the sales of the municipal plants (280 K.W.H.), including, of course, only the light and power sales. It appears that in each group the ratio of power customers to light customers is practically the same — 5.4 per cent in the public plants and 5.2 per cent in the companies. The quantity of current used for light per customer is 224 hours in the former and 250 in the latter, while the average power sold per customer is respectively 1087 (only 724 if the Wellesley waterworks, which accounts for one third of the total, be omitted) and 3,306 kilowatt hours. Probably the figure for the former would be somewhat higher than here given, were it not for the fact that a portion of the current sold for power is not separated from the commercial lighting sales. Also the municipalities seem to have reported as power customers some who have no motors and are using only those appliances which would ordinarily be classed with the lighting load.

Finally, the ratio of customers to inhabitants of the district served is only 6.9 per cent in the companies and about 60 per cent higher, 10.8 per cent, in the public plants. This is surely an excellent showing for the latter, in view of the fact that their population is more scattering than that of the other group, even though their area is not quite so extensive (19.6 square miles as opposed to 25.8 for the companies).

The accompanying table explains the more significant relations which exist between the connected loads of the two groups, though, to be sure, with the exception of the street lighting data, the figures must be taken with caution. Probably the inaccuracies are about as great in one case as in the other. At any rate the *per capita* showing seems to be markedly better for the municipal plants. This, together with the fact that their sales per customer are

much lower than in the private plants, indicates that their entire territory is more adequately supplied. It might also lead us to expect higher charges for service, because of the greater expense involved. The power load of the public plants, so far as developed, seems to be about as satisfactory as that of the other group.

TABLE 24. CONNECTED LOAD DATA (PURCHASING PLANTS, 1915)

	Companies	*Municipal*
Average per plant (K.W.)	520.0	390.5
Per capita (watts)	89	122
Street lighting load *per capita* (watts)	2.3	5.5
Per customer (K.W.)		
Light	0.914	1.000
Power	7.600	2.470
Average number of motors per plant	38	19
Average size of motors per plant (K.W.)	3.830	2.260
Consumption of current (K.W.H.) per kilowatt connected load		
Total	416	357
Commercial lighting	273	237
Power	434	400
Street lighting	3491	2615

It is further interesting to observe that, while the connected street lighting load *per capita* is almost two and one half times as great for the municipal plants as for the companies, the consumption of current per connected load (2,615 K.W.H.) is only about three fourths as high as in the other group (3,491 K.W.H.). This simply indicates that while the former are better supplied with lamps, they are not using them on the average so many hours per night. The data here computed would indicate an average of 7.2 hours use per night for every night in the year, in the public plants, and 9.6 hours per night in the private plants.

A study of the distributing system of the two groups is particularly instructive. The average length of lines per public plant is 72.9 miles, slightly higher than that of the other group, 68.7,[1] but the length, per plant, of streets

[1] If Manchester be omitted, since *all* of its construction is underground, the length becomes 71.6 miles.

with overhead lines is almost 50 per cent greater in the former (21.4 miles) than in the latter (14.8 miles). It naturally follows that the miles of line per mile of overhead are less in the former (3.6) than in the latter (4.6). The number of people per mile of streets with overhead is 139 in the municipal plants and 370 in the companies. Obviously the former have made a much more effective attempt to serve their territory than have the other group.

Upon separating the street lighting lines from the commercial lines, we find that these constitute 31.4 per cent of the total length in the companies and 34.3 per cent in the municipal plants, or, on the average, 23 and 29.4 miles per plant respectively. This indicates that the latter are showing just as much zeal in the development of their commercial business as are the private plants. But, while the length of the street lighting lines *per capita* is in the companies only 21 feet, it is in the other group 52 feet! Obviously the little municipalities are intending to light themselves at any cost! Furthermore, the length of commercial lines per customer is in the case of the companies 660 feet, and in the public plants 880 feet. In other words, there are 8 customers per mile of line in the one and only 6 in the other.

The number of poles is 794 per plant for the municipalities and 792 for the companies. The number per mile of overhead, however, is only 37 in the former and 54 in the latter.[1] But the number per mile of line is exactly the same, 11, in each case. Hence it would appear that the companies are building a more substantial line construction and probably own a larger proportion of their poles.

Practically all of these data indicate that the actual investment in physical equipment for the sake of serving the customers would, other things being equal, be much greater in the municipal plants than in the companies, — a fact which under private management would lead us to

[1] Manchester omitted.

expect higher rates, since their load factor is apparently poorer. From the statistical point of view, at any rate, it appears to be demonstrated beyond a doubt that the public plants have had a more difficult territory to serve — a territory which did not attract private enterprise — and have developed that territory remarkably well. They appear to have made a far better showing with less opportunity than have the corresponding group of companies. Here, apparently, is a complete reversal of the situation which was found in the group of generating plants, of which more mention will be made presently.

While little reference has been made to the municipal plant of Norwood, it may be stated briefly that, so far as our study has gone, it has done unusually well. This good record can be attributed to three causes: (1) As in the case of Holyoke, it serves a compact and densely populated territory (10.47 square miles), to which its business has been confined. (2) It is in an active manufacturing center, — more than half of its current is sold for power purposes. And (3) due to the influence of certain public spirited citizens, the electric plant, as well as all of the municipal affairs, has recently been managed remarkably well.

9. Extent of Territory, Roads, and Population[1]

In a study of this sort it would be highly instructive to know the exact area of the territory actually served by each group of plants, as well as the density of population of that area, and the length of roads. Certain significant relations could thus be worked out regarding the development of the district served. Some attempt has already been made in this investigation to deduce such relations, based on the total number of inhabitants in each city and town and the total inhabitable areas. The results are valuable as showing certain general tendencies. They must, however, be taken with a good deal of caution.

[1] Appendix, pp. 404–405, 423.

It is absolutely impossible to secure exact data on these points. Only within the last year has the actual area of the State of Massachusetts been known, and not until a short time ago (in 1916) was it possible to find out the net land areas of the various municipalities. Nor are these figures at present published or in process of being published. The writer has ferreted them out of the archives of the Massachusetts Waterways and Public Lands Commission (formerly the Board of Harbor and Land Commissioners), and has made his own computations therefrom.

A city or town in Massachusetts may extend over a very considerable territory, while its population may be concentrated in one small portion of that area. On the other hand, notably in the smaller towns, the inhabitants may be more evenly distributed throughout the entire district. We should have some means of distinguishing business and residential sections from purely rural districts, as to area, population, and length of roads. If the acreage of all "agricultural" lands had been correctly reported in the State Census of 1905, if there had been little change in this acreage since then, and if the total assessed acreage of each municipality, as at present reported to the Tax Commissioner, were accurate, it would be possible, by subtracting the one from the other, to find the urban areas with sufficient accuracy for our purposes, particularly in the case of the plants which do no business in foreign localities. Upon comparison, however, the discrepancies have been found to be so great that this method is out of the question.

The statistics of agriculture in Massachusetts, compiled by the Federal Census Bureau as of April 15, 1910, would, if correct, give us the areas desired. The farm acreage reported, however, is in many cases merely an estimate,[1] and, besides, only totals for counties are given. To find

[1] Abstract, U.S. Census, 1910 (with Supplement for Massachusetts): 613, 628–631.

the data for our particular groups of municipalities would necessitate the enormous and probably fruitless task of working over all of the raw material on which the census was based.

Probably the only satisfactory way to secure these data is to visit the localities studied, and from the plans kept by the municipal authorities, when there are such, compute the areas in question, and determine the length of roads. Nor, in the case of the smaller towns, would even these figures be worth much, for electrical service is frequently extended far into the rural districts. The Massachusetts State Forester is at present engaged upon just such a survey as would be useful on this matter, and has, to date, covered Worcester County and is working on Plymouth County. But it will be many years before the State is covered.

Again, the Massachusetts State Highway Commission, for the year 1914, collected data regarding the length of roads in the separate cities and towns. As these figures were based largely on returns made by the local authorities they were at first, in some cases, distressingly inaccurate. The Commission, however, by carefully checking up the returns with the United States Geological Survey maps and with other data at their command, as well as by personal verification in many instances, managed to correct the more serious mistakes, so that the percentage of error, according to the chief engineer is certainly not greater than 10 per cent. Yet, except to give the estimated length of improved and unimproved roads for the entire municipality, no data are worked out which can be of much service to us. A crude approximation of the length of roads in the thickly settled districts could be reached by going over the large Geological Survey maps and making computations by means of tedious measurements. As the Director of the Survey has informed the writer that these maps are twenty years old, and hence probably very far

from accurate at the present date, doubtless the results thus secured would still be unsatisfactory.

Taking the totals as we find them, it is instructive to note that the average land area of the districts served by the generating companies is 58.94 square miles, or 136 per cent greater than that served by the public generating plants (24.81 square miles). If, however, the foreign localities be eliminated in each case, the averages become respectively 30.67 and 21.39 square miles, the companies still being 43.4 per cent in the lead. In the purchasing plants there is not so marked a difference, as the area per public plant is 19.60 square miles and per private plant, 25.06. The greater area in the latter is wholly accounted for by the fact that six foreign localities are served.

The average length of roads of all kinds for the municipal generating plants is 83 miles and for the corresponding companies 172 miles. The population per mile of road is in the former 146 and in the latter only 98. For the purchasing plants, on the contrary, the tables are turned. While the average length of roads is 66 miles in the companies and 58 in the municipalities, the number of inhabitants per mile of road is 83 in the former and only 45 in the latter, if Norwood be omitted. Under the circumstances it is probably not worth our while to work out any relations between amount of business done and length of lines on the one hand, and areas of districts served and length of roads on the other hand, for we know too little about the distribution of service in the individual plants.

Regarding the separation of rural and urban population similar difficulties as above outlined present themselves. As the United States Census classes all places with less than 2,500 population as rural,[1] the data there found are of absolutely no use in the study of our towns and cities, owing to the peculiar meaning attached to those terms in Massachusetts. Country dwellers are not here separated

[1] Abstract, U.S. Census, 1910: 54.

from those in the thickly settled districts. However, by finding the number of "farms" in each municipality (including "general" farms, dairy farms, egg and poultry farms, and sometimes market gardens), as given in the Massachusetts State Census of 1905, checking this number up with the number of farm dwellings then reported, and assuming that there are on the average about 4.5 persons to each inhabited farm,[1] we can by a process of simple multiplication arrive at a rough approximation of the number of the rural population in each case. Of course, some of the farms will be inhabited only in the summer, and so our figures will be to that extent misleading. It might be safer to take only the "general" farms, as many of the others may be practically part of the "residential district," and to assume only 4 dwellers to each farm; but this would not have any marked effect on our averages. There are numerous methods of verifying the number of persons per farm, if we could only be certain of the number of the latter which are actually inhabited throughout the year. Yet the errors are probably pretty evenly distributed between the two groups, though only by a first-hand study of each locality can the exact conditions be determined.[2]

Having made the computations referred to, however, assuming 4.5 persons per farm, the writer finds that the total population of the cities and towns served by the municipal generating plants (Holyoke omitted) is reduced by 11,709, so that the average per plant becomes 11,424, or 5.7 per cent less than the former figure of 12,113. For the private generating plants we would have to deduct 21,852 or 7.7 per cent, which makes the average 15,532, instead of 16,817. We would naturally expect this larger

[1] Abstract, U.S. Census, 1910: 260; and Mass. Census, 1905, IV: 313–323, 407–484.

[2] It would be of some value to go carefully over the charts of the different enumerators' districts as outlined by the State Census Bureau. In the case of the smaller towns, however, even this would not give us the necessary groupings of population.

proportion of rural dwellers in the latter because of the much wider extent of territory served. Eliminating the foreign localities, which are, as a rule, not densely populated, we find the number of rural inhabitants to be about equal in the two groups.

By similar computations it appears that from the total number of inhabitants of the districts served by the purchasing companies we must deduct 10,233, or 11.7 per cent, so that the average per plant is reduced from 5,467 to 4,827. The population of the other group, however, is decreased by 12,037, or 22.5 per cent, until the average per plant falls to 2,077, whereas it was 2,679. Though the absolute decrease in number is practically the same in either case, it is interesting to observe that the percentage of country dwellers is twice as great in the districts served by the public purchasing plants as in the districts served by the other group. In making all of his computations, however, the writer has used the *total* population in each case. If the explanations just given are borne in mind, it hardly seems necessary to change the figures, certainly not in the case of the two groups of generating plants.

In spite of the individual differences which will naturally exist, it is rather surprising to find the growth of population during the five-year period as nearly as may be equal, 14.6 per cent in the municipalities with generating plants, or 11.8 per cent including Holyoke, and 14.7 per cent in the corresponding companies. Having deducted the increase in population due to the extension of service to neighboring towns, of which there are 7 in the private plants and 4 in the public, we find the rate of growth still to remain practically the same in each case, though lowered to about 11 per cent, or to 9.4 per cent for the public plants if Holyoke be included. Other things being equal, this would seem to refute the arguments of those who maintain that public plants, as a result of ultra conservatism, tend to drive away business and so retard the growth of their communi-

ties. Yet, when we recall the fact that the publicly owned plants are for the most part located in places which are devoted largely to manufacture, while the private plants are found mostly in residential districts, we might reasonably ask why their population has not increased much more rapidly than that of the second group. It may be worthy of note that, on the one hand, the manufacturing city of Holyoke has grown only 5.4 per cent in numbers, while, on the other hand, the semi-residential city of Quincy has had a 24 per cent increase during the same period, in spite of the fact that the latter has a much higher tax rate. This, however, may be in large measure due to its close location to Boston.

Two of the private generating plants, Attleborough and Leominster, show a slight decrease in population served, due to the fact that in each case a small neighboring town, whose inhabitants formerly secured their current from these companies, is now independently supplied. One of these towns, Lunenburg, now has a municipal plant, while the other, Seekonk, is served by a private concern. A third company, North Adams, shows a decrease of a few inhabitants which the writer is unable to account for. Of the similar group of public plants, two, Merrimac and North Attleborough, have also experienced some falling off in the number of inhabitants in their territory.

The groups of plants purchasing current show an increase of population served of 7.3 per cent for the 14 companies operating in 1910, and 18.3 per cent for the 9 municipal plants operating at the same date (or a 22.3 per cent increase if the manufacturing town of Norwood be included). If, however, we omit Belmont, which was subject to an abnormal growth as a result of its proximity to Boston and Cambridge, the rate of increase for the municipal group becomes only 12 per cent. Excluding another exceptional case, Wellesley, this rate would be further lowered to 6.2 per cent for 7 public plants. Three private

plants and one public plant of these groups show some decrease in the number of inhabitants of the district served. There seems to be no getting away from the fact that, in general, the communities with their own purchasing plants have grown more rapidly than those depending upon private enterprise. However, it would be rash indeed to attribute this growth solely to the benefits arising from municipal ownership. Which is cause and which is effect would be difficult to state.

The density of population, taking into consideration all of the territory and population served in both cases, is for the generating companies only 285.3 per square mile, while for the corresponding group of municipalities it is 488.2, or 71 per cent greater. If the foreign localities be left out, we still find the districts served by the municipal plants 18 per cent more densely populated (550.2 as compared with 468.1 in the companies). On the other hand, the group of companies buying their current serve a district 60 per cent more densely populated than that of the similar group of publicly owned plants (218.2 as opposed to 136.7 per square mile). This condition at once suggests the probability that these small municipalities can offer very slight inducements to private business — a probability which becomes a certainty when we recall that, though the average age of this group of municipal plants, including the time under private operation, is just about one half the age of the corresponding group of companies, yet only 8 of these municipalities out of the total of 21 were supplied by private plants or distributing systems previous to the installation of their own plants. The municipal *generating* plants, on the contrary, seem to have selected the more favorable territory.

Summary

The conditions which have been indicated by the foregoing analyses may be summarized as follows:

1. The increase in station equipment of all kinds has been more rapid for the private than for the public plants.

2. Though relative to the amount of business done, there does not seem to be much difference in the total capacity of the various units, yet this seeming equality, on the part of the municipal plants, is accounted for by only one or two large plants. In boiler capacity, 53 per cent of the public plants have remained stationary or gone back.

3. The average size of units is, in every instance, much larger in the private plants.

4. As the average *age* of station units is 20 per cent greater for the public than for the private plants, it seems reasonable to conclude that the former have not been kept in as good repair as the latter.

5. The capacity relations which the various station units, boilers, engines, and dynamos bear to each other is almost identical in the two groups.

6. In proportion to the amount of current generated, the fuel economy seems to be about the same in the two groups, with an average advantage for the companies.

7. The municipal plants have rapidly increased the proportion of current bought since 1910 from 1.3 to 12 per cent, while the companies have shown only a slight increase from 4.1 to 6.5 per cent.

8. The *load factors*, so far as ascertained, are slightly better in the case of the private plants; their *maximum demand* factor is lower; and the *diversity factors* cannot be found, though the companies appear to have an advantage in this regard.

9. Relative to the actual generating capacity of stations, the amount of business done seems to be nearly the same for the two groups.

10. The public plants have a much lower efficiency of distribution as shown by an amount of current unaccounted for relatively more than 30 per cent higher than that of the companies.

11. While the municipal plants have shown a greater percentage increase in *output*, since 1910, their rate of increase in the quantity of current actually *delivered* has been about the same as that of the companies.

12. At present the relative amount of current supplied for all purposes is practically the same in the two groups, except in so far as the sales to other companies are concerned, in which business the private plants are in the lead.

13. As to the different classes of business, the municipal plants have increased their sales for power, during the past five years, much more rapidly than have the companies, while the latter have increased their lighting business more rapidly than the former.

14. The companies are somewhat in the lead both in the quantity of current *generated* and in the amount *actually supplied* per kilowatt capacity of dynamos.

15. The average service *per capita* seems to be about the same in both cases; but the *per capita* consumption of current for street lighting is 50 per cent higher in the case of the municipal plants.

16. There has been a more rapid growth in the total number of customers of the companies (103 per cent as opposed to 90.2 per cent). In the separate classes of business, however, the number of power customers has increased more rapidly in the municipal plants, though the companies are still absolutely in the lead, averaging 91 customers per plant as opposed to 62 in the other group. The number of light customers, on the other hand, has increased more rapidly in the private plants, evidently due to their more liberal policy of extension.

17. The number of customers per 100 population has increased more rapidly for the companies, though on account of the wide extent of territory served, the ratio is still about the same as that of the municipal plants.

18. The average amount of current sold per customer is slightly greater in the case of the companies.

19. Though the connected load data are highly unsatisfactory so far as the public plants are concerned, the rate of increase in the total reported load is about equal in the two groups and corresponds closely to the increase in current sold.

20. The relative distribution of the connected load among the various kinds of business is about the same in each group, but there has been an absolute percentage decrease of the commercial lighting load for the municipal plants.

21. Both the total number of lamps per plant and the number per customer have increased much more rapidly in the companies, while there seems to have been an actual decrease in the number per customer in the municipal plants. This, however, may not be a true bill, since the municipal plants would naturally be inclined to estimate their load more carelessly than the companies.

22. There has been a more rapid increase of the connected power load of the public plants, and the average capacity of their motors, as reported, is somewhat higher than in the other group. This may be due to incorrect returns, and also to the different character of the industries carried on in the separate localities.

23. While the connected load *per capita* is higher for the public plants, the connected load per customer, though it has decreased slightly, is still somewhat greater for the companies.

24. There appears to have been a decrease in quantity of current consumed per kilowatt connected load in the companies and an increase in the municipal plants — probably due to the more conservative policy followed by the latter in the matter of extensions.

25. The rate of increase in the total number of street lights, as well as the decrease in the number of inhabitants served by one light, has been much greater for the companies, though the *per capita* figures are still absolutely

greater for the public plants. Both groups show a marked increase in lamp efficiency, and the municipal plants appear to have a longer number of hours' use of lamps per night.

26. In length of lines, the rate of increase has been much more rapid for the companies; in length of streets with overhead lines, about twice as great; while in the number of poles owned, their growth has been almost three-fold that of the other group.

27. There has been an increase in the length of lines per customer in the companies and an actual decrease in the municipal plants.

28. The municipal plants to a large extent use privately owned poles instead of installing their own.

29. There has been a rapid growth of underground construction in the companies and apparently none whatever in the municipal plants except in the case of Holyoke.

30. Though it is practically impossible to make a separation between rural and urban territory, population, or roads, so far as the totals are concerned the districts served by the companies exceed those served by the municipal plants in all of these respects.

31. The rate of growth of population seems to have been about the same for the two groups of generating plants, while for the purchasing plants there has been a more rapid increase in the case of the municipalities.

32. The density of population is much greater in the districts served by the municipal generating plants than in the districts served by the corresponding group of companies. On the other hand, the density of the population of the area served by the municipal purchasing plants is markedly less than that of the purchasing companies.

33. The two outstanding municipal plants of Holyoke and Norwood have certainly done well; but their good record is probably accounted for by local conditions rather than by good management solely. Though beyond a doubt they have been excellently managed, they have a more

favorable territory, due to no efforts of their own, and better business than any of the other plants studied.

Tentative Conclusions on the Physical Results of Public Ownership

Finally, though in some instances there seems to be little to choose between the two groups, and though at times the tendencies are not very marked, practically all of the physical data of the generating plants appear to indicate that in spite of their less desirable territory the companies have been more active in the development of that territory, and have made better provision for future needs. The municipal plants, on the other hand, for the most part seem to be operating in more favorable localities and to be letting their business grow up around them.

For the purchasing plants, however, our analyses of the physical data lead to almost the opposite conclusions. Viewed from almost every angle, this group of public plants seem to be making more out of their poorer territory than do the corresponding companies with a more favorable district to serve. They appear also to have secured as customers a larger percentage of the inhabitants in the less desirable portions of their districts, and to have a much more efficient distributing system per customer.

CHAPTER V

FINANCIAL STATISTICS OF GENERATING PLANTS: THE CAPITAL ACCOUNT [1]

THOUGH it would be highly interesting to the account to make a careful study of the financial history of each group of plants from the very beginning, to do so would necessitate the expenditure of an enormous amount of time for which the recompense would be comparatively small. Accordingly, having made some analysis of the laws of the State in so far as they relate to the financial management of the electric lighting business, having reviewed the work and policies of the Board of Gas and Electric Light Commissioners, and having surveyed in a general way the development of the industry in Massachusetts under both public and private ownership, we will in this chapter usually refrain from delving into the ancient history of our plants. The study will, for the most part, be confined to the years 1910 and 1915, with a more detailed analysis for the later date. As in the preceding chapter, the generating plants will be first and more fully considered. Since a reasonably thorough examination of the physical characteristics, equipment, and development of the two groups has already been made, the writer hopes, on the one hand, that his interpretations will be less likely to go astray, and, on the other, that his readers will have less difficulty in following his line of argument.

Before taking up the subject of operating expenses, operating income, and fixed charges, we must logically devote some attention to the capital account. At the very outset of this financial investigation, however, we are confronted with difficulties which are well-nigh insurmount-

[1] Appendix, pp. 424–431.

able, occasioned by the fact that the accounting procedure of public and private plants is by no means uniform. This is in part the result of the different methods which the two groups employ in financing themselves. A further complication arises from the provision of the law which requires municipal plants to write off 3 per cent for depreciation each year,[1] while imposing no such restriction on the companies, which accordingly handle the matter in diverse ways. And, finally, the Board itself has probably not given as much attention as might be desirable to the problem of securing from the two classes of plants data that would be conveniently comparable.

However this may be, we are at first glance somewhat at a loss to know exactly what *is* the "investment" in either a municipal or a private electric lighting plant. In each case several possibilities suggest themselves, even though we waive all consideration of the different bases of valuation, which can really throw little light on our problem. So far as the *assessed valuation* of the *companies* is concerned, for obvious reasons it usually bears no accurate relation to the investment of stockholders and creditors in the plant. This valuation is upon the average more than 25 per cent below the book value. Hence, since we must depend upon the returns for our information, it becomes a question either of taking, as the true investment, the total cost of plant as shown by the books, — the construction accounts, which have sometimes been depreciated and sometimes not,[2] — or, in lieu of this, of assuming that the total liability of the company for stock, bonds, notes,

[1] Mass., 1914, ch. 742, sect. 114.

[2] The "plant accounts" ordinarily include — cost of real estate (lands and buildings are not always separated), steam plant, electric plant, water power plant, lines, transformers, meters, street lamps and fixtures. No "working capital" is included, and no allowance is made for materials, tools, or other equipment of a transitory sort. Such allowance is unnecessary for our purposes, though it must always be borne in mind when valuation problems are under discussion.

and premiums on stock if such there be, will give us the true index of capital investment. Since the law requires that all stock shall be fully paid up, and shall be sold for not less than par, and that for every dollar borrowed a dollar shall be put into the business by the stockholders,[1] the latter would be a reasonably safe criterion, were it not for two considerations. In the first place, large surpluses are frequently built up out of earnings, and in the second place, while most of the numerous outstanding notes represent *bona fide* investment, there are cases in which they may have been issued to cover losses due to bad management, bad luck, or even to exploitation by other interests in control. Did the Board have control over the issue of coupon notes as well as over that of stock and bonds, this difficulty should be largely removed.

A further complication arises, however, resulting from the fact that several of the plants are composite, and it is not possible from a study of the accounts to determine exactly how much of the liability was occasioned by the gas business and how much by the electrical business.[2] Upon an examination of all of the data available, it is reassuring to find that for the 12 purely electric companies, the total book value is just 4 per cent higher than the total amount of capital, loans, and premiums. Hence, whichever figures we use, it will make little difference. Even though in individual cases there is frequently a considerable discrepancy, the averages will be sufficiently accurate.

Since an excess of construction accounts over capital and loan liabilities is, when existent, doubtless built up out of reinvested earnings, the writer has always taken the former as the true investment, except when the latter exceed this account, in which case the capital and loans

[1] Cf. ch. II, p. 49.

[2] In the case of the five municipal plants which are more or less linked up with the public water supply system, Concord, Ipswich, Merrimac, North Attleborough, and Hudson, the accounts are kept sufficiently separate to occasion no great difficulty.

have been taken; for, even granting that the sum of these may not always represent "live" plant, it probably does indicate that so much money has been invested, whether wisely or unwisely, — a point which will be later referred to in connection with our study of depreciation. In accordance with this method of reckoning, then, there can be no doubt that the capital account of the companies is made sufficiently high.

For the public plants the problem is less simple. Two different plant accounts are kept, the *total (gross) plant cost* — since 1912 *not* including payments of any kind from the depreciation fund — and the *depreciated plant cost.* The latter accounts average more than 25 per cent lower than the former, though in several instances the two are identical. In the depreciated plant account, as published annually by the Board, additions from construction fund and other sources as well as renewals from the depreciation fund are at present debited. The account is then credited with the statutory amount of depreciation, apportioned among the various items more or less arbitrarily according to the judgment of the manager, and with other items which are written off. Theoretically this account should represent the actual financial condition of the plant, and it might be expected to correspond with the plant account kept by the companies. Practically, however, such is not the case.

In the first place, the practice of writing off 3 per cent depreciation annually (before 1906 the rate was 5 per cent), and the customary accumulation of a depreciation fund which is carried as an asset, makes the municipal plant account disproportionately low as compared with the accounts carried by the companies, some of which, to be sure, have very regularly written off their depreciation, but many of which provide for it in their operating accounts. Furthermore, the latter rarely carry a depreciation fund account. Consequently, when their plant account is cred-

ited with depreciation, a corresponding increase will ordinarily appear in the entry for "additions made during the year," as a result of renewals, new construction, and so forth.

But, secondly, the "dead" assets of the municipal plants are usually written off promptly, so as to show a low plant account, even though the original loan may be still outstanding. The companies, on the other hand, for sufficiently obvious reasons, frequently let their accounts stand as they originally were, even though a portion of the plant may be defunct. But, whenever they apply to the Board for the approval of a new issue of securities, this aspect of their finances is thoroughly investigated, and if a discrepancy is found to exist between the book value and the liability for capital and loans, the company is required to put aside from earnings until the deficit is made good.[1]

The *gross* plant account of the municipal plants, which is never published by the Board, more nearly corresponds to the account carried by the companies, for, though it is undepreciated, no additions from the depreciation fund, even after a transfer has been made to the construction fund, are included. The dead assets are not as a rule written off, since the account is intended to show all the money that has actually been invested in the plant from the beginning. These accounts, however, are not similarly kept by the various municipalities. Some include additions from earnings — which is perfectly proper, though a most insignificant item — while others do not. Some persist in depreciating the account and debiting the renewals from depreciation, so that it coincides with the published plant account. And, finally, one or two, while not depreciating this account, have continued to include payments from the depreciation fund not merely for new construction but for renewals, as they did prior to 1912. For these reasons this account, in individual cases, is not wholly satisfactory,

[1] Mass., 1914, ch. 742, sect. 40.

particularly for the earlier period. To make the 1910 accounts absolutely comparable with those for 1915, would in some instances be a task which would require the services of a staff of expert accountants.

In view of these difficulties, the writer has chosen, as most nearly representing the true investment in the public plants, the so-called *total investment* as computed from year to year by the Board. These figures include all amounts which have been invested by the municipality in each plant since its installation, whether raised by loans or by direct taxation, and at a given time would be indicated by the bonds and notes outstanding, the appropriations for bond and note payments, and the appropriations for construction. It is frequently necessary to go back over the returns for a number of years in order to find the exact basis of computation, for occasionally one note has been taken up by another, and sometimes a payment has been made from earnings, thus leaving no recorded liability in the published accounts of the plant. The aggregate investment as thus computed coincides so closely with the gross plant cost as above discussed, being only 1.2 per cent below it, that, except for the sake of convenience in making comparisons with 1910, it would really matter little which figures we take for 1915.

The chief reason for the slight difference between the two totals is due to the fact that in one or two cases a small amount has been added to the plant out of earnings. In Holyoke, of course, there has been a considerable addition from this source, and so the *gross* cost has been used. It should also be noted that in the case of all the composite plants the *total* cost has been used, except in the one instance of Wakefield, where this seemed not to represent the true investment. In these cases any attempt at a division of liabilities between the two branches of the business would be purely arbitrary, based on the relations which the electric assets bear to the gas assets.

The writer believes that, with these explanations and qualifications, the investment data herein presented are reasonably comparable, though far from satisfactory. They do not by any means necessarily represent the actual value of the property in either case — indeed, they are frequently far from it. Consequently, conclusions derived from the use of these figures will be relative rather than absolute. Whenever feasible, exceptional cases will be lost sight of in the group averages. Otherwise attention will be given to each anomaly as it presents itself. Upon the whole, it is probably safe to assume that the conditions indicated by this particular study are not far from the truth.

Upon comparison of the total investment in each group, as arrived at in the manner outlined, a number of highly interesting conditions become apparent. The total investment per company was, in 1910, $187,067, or 36.5 per cent more than that of the average public plant, which stood at $137,461. During the five-year period, however, the rate of increase of the former was 66 per cent, and for the latter only 25.1 per cent, or 28.6 including Holyoke. Hence in 1915 the average investment per plant was $171,990 for the municipal group and $310,840, or 81.2 per cent higher for the private plants.

Probably the casual student would be tempted to say, — "There we have it. Public financing is more economical than private financing!" But we must not be led into any hasty conclusions. These apparent differences in the investment accounts must be interpreted in the light of the facts which have been reviewed in the preceding chapter, and of other facts which are presently to follow. The accompanying table will help to recall to the reader the general features of the physical development of the two groups of plants.

Now, it appears that the private plant investment in 1910, in proportion to the amount of business done, was

Table 25. Generating Plants — Relations between Investment, Equipment, and Extent of Business (Holyoke excluded)

Average per plant	1910			1915			Rate of increase, 1910–1915		
	(1) Municipal	(2) Company	Excess of (2) over (1) (per cent)	(1) Municipal	(2) Company	Excess of (2) over (1) (per cent)	(1) Municipal	(2) Company	Excess of (2) over (1) (per cent)
Total investment	$137,461	$187,067	36.5	$171,990	$310,840	81.2	25.1	66.0	160.0
Station investment	72,166	109,374	51.7	97,138	150,999	55.5	35.2	37.8	7.4
Distribution investment	65,295	77,693	19.0	74,852	159,841	113.6	14.6	105.4	622.0
Kilowatt capacity	665	900	35.3	951	1,366	43.6	43.0	52.0	21.0
Average K.W. per dynamo	174	158	—9.2	269	314	13.0	54.6	100.0	80.0
Current delivered (K.W.H.)	516,688	854,443	65.3	881,914	1,437,544	63.0	70.1	68.2	—2.7
Length of all lines including underground (miles)	109.0	136.7	25.4	174.0	256.1	47.2	60.0	87.3	45.5
Length of streets with overhead lines (miles)	30.2	33.8	11.9	41.1	55.9	36.0	37.4	65.3	74.6
Length of conduits (miles)[1]	...	3.5	...	?[2]	21.1	...	...	503.0	...
Length of cables in conduit (miles)[2]	...	4.2	...	?	123.3	...	...	2,836.0	...
Number of street lamps	466	377	—19.1	673	677	0.6	46.7	79.6	70.5
Number of poles	1,053	1,507	43.1	1,355	2,655	96.0	28.7	76.2	165.5
Number of customers	559	679	23.5	1,063	1,377	29.5	90.2	103.0	14.4
Age of station units (years)	...	...	...	9.1	7.6	—16.5	...	...	...

[1] Total for group.
[2] There is no provision in the municipal plant *return forms* for the recording of underground construction. Holyoke alone appears to have conduits.

by no means excessive when compared with the investment in the municipal plants. On the contrary, when we consider that the quantity of current sold by the former was 65.3 per cent higher than that delivered by the latter, while the kilowatt capacity of generators was only 35.3 per cent higher, it is probable that, relatively, the companies were somewhat under-equipped. Furthermore, from the fact that their length of streets with overhead lines was only 12 per cent greater than that of the public plants, it is evident that their territory had not been comparatively as thoroughly developed. For these reasons the spread between the average investment in the two groups was not great, and was almost identical with the difference in kilowatt capacity of stations. One seems to have been just as conservatively financed as the other, with the doubt probably in favor of the private plants. But, for the same reasons, we can expect to find a more rapid increase in investment in the companies as service is more widely extended throughout the districts served and as future needs are anticipated.

Assuming, then, that we start in 1910 with a fairly accurate basis of comparison, we must discover why the increase in investment has seemingly been so much more rapid for the companies. Accordingly, first of all, we note that, while there is no underground construction in the 17 municipal plants (Holyoke has about $90,000 in underground cables and conduits), and while there was almost none of it in the companies in 1910, the increase has been extraordinarily rapid, though confined almost solely to the two companies of Gloucester and Beverly. This one item alone accounts for an increased investment of more than $350,000, which is not met with in the public plants, and if this amount be deducted from the total investment of the former, the rate of increase becomes only 55 per cent instead of 66 per cent.

Again, the increase in number of poles owned has been

so small in the public plants, due to the fact, as above explained, that they have been impressing foreign poles into their service, that this one item further seriously distorts the comparative figures of investment. Had the increase in the companies been at a like rate, 28.1 instead of 76.2 per cent, they would in 1915 have had at least 12,000 fewer poles than they actually report at that date. Allowing about $15 per pole, by no means an excessive price as nearly as can be ascertained, to cover the cost of pole, setting, cross-arms, braces, pins and insulators, and incidentals, we would be able to account for an additional increase of from $175,000 to $200,000 in the private plant investment. If this amount be deducted from the total, as well as the $350,000 for underground construction, the rate of increase in the investment of the companies becomes less than 49 per cent, while the excess of their investment over that of the municipal plants is reduced to only 62 per cent instead of 81.2 per cent. In view of the fact that the amount of current disposed of by the former is 63 per cent greater than in the latter, and also by reason of the fact that they are extending their distribution systems much more widely at the present time, this difference in investment is by no means disproportionate. Other reasons for the difference will be given presently.

But this is not the whole story. While there has been a considerably more rapid growth in the generating capacity of the companies (52 as opposed to 43 per cent in the other group), the increase in the average size of these generators has been almost twice as great (100 per cent as contrasted with 54.6 per cent). This naturally means a much more rapid increase in station investment, for in most instances the change from smaller to larger units has been in the nature of an addition or improvement rather than a renewal, and so may lawfully be considered a capital charge.

Furthermore, the length of lines has increased almost

50 per cent more rapidly in the companies, and the length of roads with overhead lines nearly 75 per cent more rapidly.[1] Since the number of miles of line per mile of overhead is about the same in the two groups, 4.5 miles, the increase not only indicates a relatively greater investment for wire and other materials, but it also probably signifies that the labor costs of extension have been more than proportionately higher as a result of the distribution of service over so much wider an area, where frequently, on account of the rocky character of the soil, construction is a very difficult and expensive matter.[2]

The more rapid growth in number of customers in the private plants brings with it a correspondingly greater investment in customers' meters. The much more rapid increase in the number of street lamps also occasions a considerably higher ratio of increase in investment. Finally, in a number of cases which cannot well be ascertained, the customers of public plants have borne the cost of extensions on their own property — a practice which aids in keeping the line investment comparatively low.

The writer believes that the more rapid rate of increase in investment in the companies is fully accounted for by the foregoing considerations, not to mention a number of others. But we should not overlook the fact that in some cases part of the increase *might* be due to bad management. This may be accounted for by lack of foresight and judgment on the part of those who manage the business, or it may be the result of actual exploitation by associations or individuals who control a majority of the stock. This exploitation may be of two sorts, first, the distribution of

[1] It is true that companies might be more inclined to keep "dead" wire on their books than are the public plants, for in case of rate disputes or new security issues, there might be some advantage in making the physical property look large. There is, however, no reason to suppose that this tendency has been more marked since 1910 than before that date.

[2] Cf. ch. XI, p. 305. The local survey has shown this to be a fact.

the highest possible dividends, and the consequent provision for depreciation out of new capital raised by the issue of notes — the payment of dividends out of capital. And, secondly, material may have been sold to the companies by controlling associations at an abnormally high price, which would yield the favored stockholders a handsome return, even though no dividends at all should be paid on their stock. The additions to plant thus made would unduly inflate the capital account.

At first glance, the internal evidence seems to suggest that some of these things might have happened in the case of Plymouth and Weymouth in both of which the investment appears to have increased more rapidly than circumstances would warrant, though in the latter the investment per kilowatt capacity is low. In both of these plants, also, there were, in 1915, an abnormal number of notes outstanding, $162,499 and $217,000 respectively,[1] or in each case 40 per cent of the capital and loan liabilities, while in 1910 the amounts were only $54,000 and $36,000 — still rather large. However, so far as the writer has been able to ascertain, his theoretical deductions regarding these plants are scarcely justified at present, though during the year no depreciation was charged off. Amesbury, also, appears to have been rather badly managed earlier, and returns a higher investment than we would have expected in spite of the low investment per kilowatt capacity. On the other hand, probably most, if not all, of the rapid increase of investment in these plants can be accounted for by the enormous growth of their lines and streets with overhead lines, averaging 150 per cent and 120 per cent respectively. Accordingly, if these three companies, together with Gloucester and Beverly,[2] all of which are abnormal, be eliminated, even though their investment

[1] The amounts were later greatly reduced.

[2] Cf. p. 133, *supra*. Their underground construction has been very large since 1910.

has not increased more rapidly than their business, the rate of increase of investment in the private plants becomes 41.2 per cent, in place of 66 per cent. And if, in addition, we leave out Buzzard's Bay, which was at its inception in 1910, the rate drops to 31.3 per cent, or little higher than the rate of increase in the municipal plants.

Hence, from every point of view, the conclusion thus far reached seems to be that on the average the group of private plants suffers nothing in comparison with the public plants so far as their investment is concerned, and, if a few of the exceptional cases be eliminated, the remaining companies make a somewhat better showing than the municipalities.

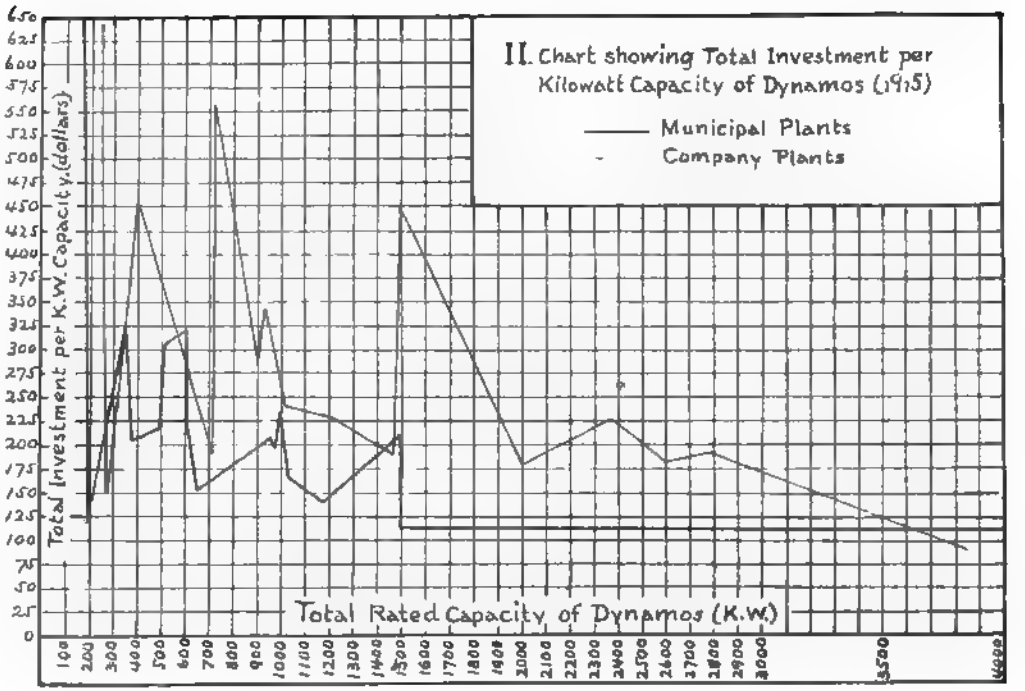
Upon analysis it appears that the total investment per kilowatt capacity of dynamos in the two groups, while practically the same in 1910, was considerably higher (30 per cent) for the companies in 1915.[1] For the municipal plants the decrease had been 15 per cent, from $207 to $176, while the other group showed an increase of 9.6 per cent, from $208 to $228. Most of the increase in the latter, however, was accounted for, as has been explained, by the construction of conduits and the installation of new poles instead of the utilization of foreign poles as in the case of the public plants. If, in order to make our data comparable, we deduct the cost of these items, about $550,000, the investment per kilowatt becomes $24 less, or $204, an actual decrease of 2 per cent for the period. Half of the remaining difference of $28, is easily accounted for by the more rapid rate of extension of lines in the companies. The rest is probably covered by the other items above mentioned. So again, after reasonable allowances have been made for the obvious differences in physical development, the total investment per kilowatt capacity

[1] At both dates Great Barrington and Winchendon are omitted from the list of companies, because their large investment in water power facilities makes their capital account abnormally high.

will have decreased at approximately the same rate in both groups. The accompanying chart (II) shows the investment relations existing between the individual plants. It is for the most part easy to account for the conspicuous peaks in the graph for the companies. The first two are due to the comparatively large investment in water-power development, with a correspondingly low generating capacity, found in Winchendon and Great Barrington. The next high point shows the condition of Plymouth, which was at the time doing a large business with a disproportionately small generating equipment,[1] and in which there has actually been a decrease in the kilowatt capacity of dynamos since 1910, in spite of a 150 per cent increase in the number of customers and a *200 per cent increase in the length of lines*. The last peak represents Beverly, in which, as already stated, the cost of underground construction figures heavily. Charts III and IV throw further light on the situation.

The question may at this point be asked, why, when the more obvious differences between the two groups have been eliminated, the investment per kilowatt capacity is not lower in the private plants, which are somewhat larger, than in the public plants. This fact is not in itself significant, for reasons that are about to be given. But several obvious replies might be made to the query. (*a*) The difference in size is not great enough to have much effect upon the per capacity investment. (*b*) There might be a higher proportion of "dead" assets in the plant account of the companies, in spite of the fact that the average age of their station units (7.6 years) is markedly less than the age of the municipal plant units (9.1). (*c*) The companies may, in some instances, not have bought their equipment so economically as have the other group — Massachusetts municipalities are noted among the

[1] Plymouth has since found it necessary to purchase her current most of the time.


II. Chart showing Total Investment per Kilowatt Capacity of Dynamos (1915)
Municipal Plants
Company Plants
Total Investment per K.W. Capacity (dollars)
Total Rated Capacity of Dynamos (K.W.)

trade as "shrewd bargainers." And (*d*) the real estate investment as reported by the public plants does not in many cases represent the true value of the property used. Four of them, Ipswich, Merrimac, North Attleborough, and Wakefield, report no land whatever, as it is owned by some other municipal department. One plant, Merrimac, reports neither building nor land. Several of them do not separate the value of their land from the value of their buildings, and probably most of them place too low a value upon the land originally secured from the municipality itself. Also since they frequently depend upon the town hall or some other public building for their office room, they have not found it necessary to enlarge their building capacity for this purpose as has often been the case with the private plants. If the value of the reported real estate, amounting to $857,368 and $356,609 respectively,[1] is deducted in each group, as well as about $550,000 for underground construction and excess increase in new poles for the companies, the average investment per kilowatt capacity becomes $167 for the companies and $159 for the public plants, notwithstanding the fact that the distributing system of the former covers a much more extensive territory.

In this connection it should be observed that for all municipal and private electric light and power stations in the United States in 1912, the total investment per kilowatt capacity of generators was for the former $289, and for the latter $424.[2] Evidently the financial management of both public and private electric plants in Massachusetts is, comparatively, *unusually conservative*, and the two groups seem to be in this State more nearly on the same footing.

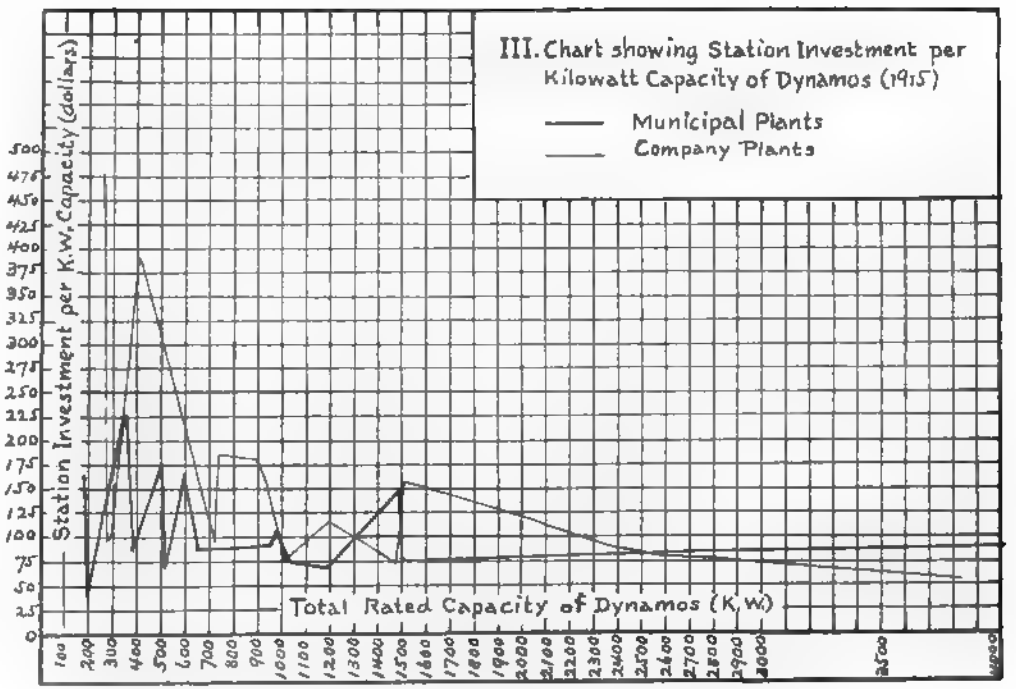
If we separate the investment in station and real estate

[1] Additional reasons for the low investment in real estate became painfully evident after the local survey was made. Cf. ch. XI, *infra*.

[2] Central, 1912: 66.

on the one hand from the amount invested in the distribution system on the other, some very significant relations can be discovered. In the first place, the growth in station investment has been about the same in the two groups, 38.1 per cent in the companies and 34.6 per cent in the municipalities. This slight difference is more than accounted for by the greater increase in total capacity and in average size of dynamos in the former. The averages for station investment per kilowatt capacity are very close together in both groups, $111 for the companies and $101 for the public plants, and they have decreased at a fairly equal rate, from $116 in the one case and from $107 in the other. If we deduct the investment in real estate, which is more than 140 per cent higher in the companies than in the municipalities, for reasons which have been in part suggested, the station investment per kilowatt capacity is found to be *less than $74 in the former* and *$80 in the latter*, a condition which certainly speaks well for the private plants in view of the fact that their equipment is also newer than that of the other group. Finally, the station investment per kilowatt hour generated is only 8.4 cents in the companies and 9.5 cents, or 13.1 per cent higher in the municipal plants. From these analyses it is reasonably evident that the station economy, so far as equipment is concerned, is somewhat greater in the privately owned plants.[1] Chart III shows the close correspondence of station investment per kilowatt capacity in the two groups, and the two noticeable peaks caused by investment in water power development have already been explained.

[1] The individual plants, in such analyses as these, present many anomalies, particularly in the matter of investment per kilowatt capacity. In some cases, of which Holyoke is a good example, the installation of a large additional dynamo capacity within the year serves to make the data for 1915 entirely disproportionate to those for 1910. It might be interesting, but not highly useful, to attempt to explain these individual cases which seem to vary widely from the average.


III. Chart showing Station Investment per Kilowatt Capacity of Dynamos (1915)
Municipal Plants
Company Plants
Station Investment per K.W. Capacity (dollars)
500
475
450
425
400
375
350
325
300
275
250
225
200
175
150
125
100
75
50
25
0
Total Rated Capacity of Dynamos (K.W.)
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
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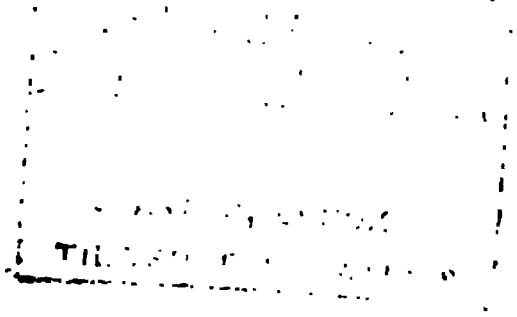
2800
2900
3000
3500



The investment in distributing system in 1910 was 47.5 per cent of the total investment in the municipal plants and only 41.5 per cent in the case of the companies. But five years later these relations had so reversed themselves that the ratio was only 43.6 per cent in the former and 51.5 per cent in the latter. This is truly a remarkable situation, for, while the increase in investment in distribution system was only 14.6 per cent in the public plants, that of the private plants was 105.4 per cent — a sevenfold more rapid increase! If the increase due to the construction of conduits be deducted, the rate would still be nearly 80 per cent.

Furthermore, it must be observed in this connection that the station investment of the municipal plants, as given for 1910, is somewhat too high, due to the above mentioned practice, in many cases, of charging to the undepreciated capital account renewals from the depreciation fund. This largely explains the fact that 5 of the plants, including Holyoke, actually report a lower station cost in 1915 than in 1910, though some of them have simply written off their worn-out equipment. All of the public plants revised their accounts for the correction of this error in 1912. Hence, if the proper allowances were made, we would accordingly find the rate of increase in station investment considerably higher than it now appears, and the proportionate decrease in distribution investment even more marked than it is here shown to be.

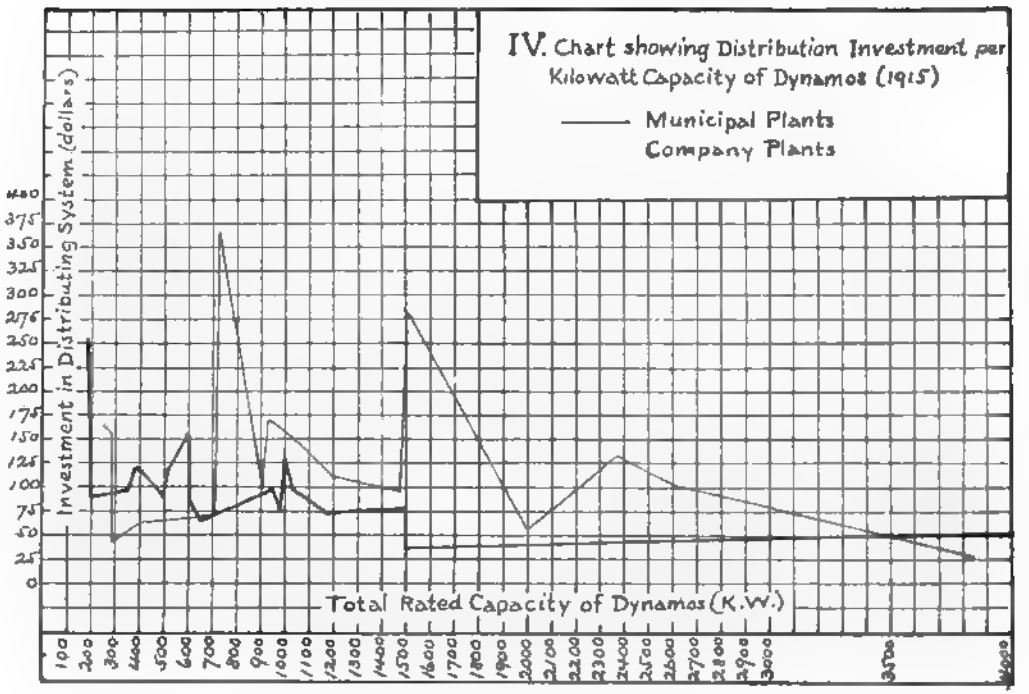
Now, the proportion of current purchased by the municipal plants increased from practically nothing, 1.3 per cent of the total output in 1910 to 12 per cent in 1915. For the companies, on the other hand, the proportion increased from 4.1 per cent at the earlier date to only 6.5 per cent at the end of five years — a change which is practically negligible. In view of these facts, it is sufficiently surprising to find the rate of increase in station investment of the former to be so nearly equal to that of the latter. At any

rate, we would naturally expect a correspondingly more rapid growth in their line investment, since they obviously are, or should be, distributing more current than formerly in proportion to their generating capacity. But, as we know that several of the municipal plants are quitting the business of generating current, to find their station investment (Holyoke excluded) increasing nearly two and one half times as rapidly as their distribution investment, with nothing to show that this is caused by any special effort to prepare for future business, "needs must make us pause."

To be sure, some allowance must be made for the fact that the municipal plants had a somewhat better developed territory than the companies in 1910. Hence we would not expect their rate of development to be equally rapid. Yet such a difference as we *do* find is almost unbelievable. Nor has the increase of the companies' investment been a reckless increase, if we may take the standard set by the municipalities as our criterion. In fact the former have relatively a good deal more to show for their increased investment than have the latter. Under these circumstances, the results of municipal ownership herein discovered are, to say the least, rather surprising. The public plants have apparently played reasonably safe; but, unless all signs fail, they have done so at a considerable sacrifice of that service which they might legitimately be expected to render. And *this* is probably the most decisive consideration in the argument for or against public ownership.[1]

The distribution investment per mile of line was, in 1910, $600 for the municipalities and $574, or 4 per cent less, for the companies. In 1915 the figures had changed to $430 for the former, a decrease of 28.3 per cent, and to $624 for the latter, an increase of 9 per cent. But this figure includes the conduits, which we must eliminate in order to secure comparable data, whereupon the com-

[1] Cf. ch. xi, pp. 309, 340–342.


IV. Chart showing Distribution Investment per Kilowatt Capacity of Dynamos (1915)
Municipal Plants
Company Plants
Investment in Distributing System (dollars)
Total Rated Capacity of Dynamos (K.W.)

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pany distribution investment per mile of line drops to only $420, a decrease of 27 per cent, and absolutely about 2.3 per cent lower than that of the public plants. But, in order to make the comparison really valid, we must go still farther and eliminate those new poles which the companies have installed in addition to the number which, with their correspondingly more extensive business, they would have installed, had they pursued the policy adopted by the municipal plants. When a reasonable deduction is made on this account, the distribution investment per mile of line becomes for the companies $350 to $375, or from 15 to 20 per cent lower than the investment of the public plants! Probably the reader will now be sufficiently satisfied that, so far as we can secure the evidence, the greater increase in investment of the private plants not merely has been fully accounted for, but they even seem to have gotten a good deal more for their money than have the municipalities. Aside from any theorizing, these appear to be the facts.

As it has frequently been alleged that the municipal plants taken over from private ownership have been at a decided disadvantage inasmuch as they paid too much for the property which they acquired, a passing comment should be made upon the actual state of affairs which our analysis reveals. Accordingly, it appears that for the 6 plants, — Chicopee, Hudson, Hull, Middleborough, Taunton, and Westfield (Wakefield is omitted because it had definitely ceased to generate current early in the year 1914–15), — the total investment per kilowatt capacity of generators is only $154, or 12.5 per cent lower than the average for the group, $176! And this is in spite of the fact that two of the plants included, Chicopee and Hull, were buying a large proportion of their current, and hence have had no reason for increasing their generating capacity. Furthermore, Taunton and Westfield have the lowest per capacity investment of any in the group of

public plants, $111 and $113 respectively. The station investment per kilowatt capacity is $108 as opposed to $101 for the group — a condition easily explained in view of the fact that so much current is being purchased. The line investment per mile, on the other hand, is $500, or about one sixth higher than the average for the group; but *this* investment was acquired long after the plants had become municipalized! Holyoke, as might be expected, makes a better showing in all of these regards than do most of the other plants in either group, the total investment per kilowatt capacity being only $112.[1] Obviously there is absolutely no ground for the above mentioned charge.

Some additional analyses must be made of the total plant investment. It appears that the total investment per kilowatt hour supplied is 20 cents in the municipal plants and 22 cents in the other group. While this has remained practically stationary in the latter, in the case of the former there has been a decrease of 23 per cent, from 26 cents in 1910. This would seem to be an excellent showing for the public plants were it not that we have discovered how the decrease has been effected. Again, the investment per kilowatt connected load is $126 in the companies and only $100 in the other group. And, finally, the investment per customer has decreased in both cases, but about twice as rapidly for the public plants, so that the figures now stand at $162 for the latter and $226, or nearly 40 per cent more, for the former.

In view of the relations here set forth, which scarcely need further explanation after what has already been said about the physical equipment and the investment of the two groups, we might logically expect the rates charged by the companies for the same kind of service to be higher than the rates of the municipal plants, for they would need to secure a return on a relatively larger investment

[1] The private plant of Attleborough, however, greatly betters this record, with a total investment per kilowatt capacity of only $90.

per customer. Had the increased investment been recklessly incurred, we could bring a serious charge against the companies. But, since the contrary is evidently the case, inasmuch as the additions to plant account have been for the purpose of taking better care of the trade, it appears that the private plants are to be praised rather than condemned.

The *per capita* investment, due to numerous reasons already reviewed, while lower for the companies in 1910, has increased much more rapidly than that of the public plants (44.9 per cent as opposed to 9.2 per cent), until the amount is now $18.48, or 30 per cent higher than the *per capita* investment of the latter ($14.20). In view of our findings on the subject, this appears to indicate a relatively greater expenditure of 30 per cent for the purpose of giving the people better service.

Finally, it is highly significant to note that, while the public plants have reduced their investment per dollar of operating income by 17.5 per cent, from $5.27 to $4.35, the companies, when the street lighting income has been deducted in order to make the data comparable, have actually increased their investment per dollar of operating income from $4.20 to $4.60, or 9.5 per cent. This fact furnishes us tentative proof that the latter are not keeping their rates higher because of their increased investment, but rather that they are investing far ahead of their present returns. The public plants, on the contrary, in the light of the facts which we have examined, (*a*) must be charging more for service than the comparative conditions would warrant, or (*b*) they may be restricting their investment and picking their business, or (*c*) they may simply be unusually fortunate in the territory which they happen to serve. The second and third of these assumptions have already been found to be true; the first possibility will be presently examined.

Before leaving the discussion of the investment statis-

tics, attention must be directed to one other important feature, namely, the comparative amount of new construction found in the two groups during the year 1914–15. As the companies keep their books, the gross additions to plant account, including renewals from depreciation, was $406,795, or 8 per cent of the book value. The *net* addition during the year, after depreciation and all other credits have been deducted, was $267,345, or 5.3 per cent of the book value. This was 36.5 per cent below the average annual increase in investment during the five-year period, $421,827 — a condition which can probably be accounted for by the abnormally high cost of material during the latter portion of the year.

The municipal plants report a gross increase in plant account, including new construction from all sources as well as renewals from depreciation, of $150,640, or 6.8 per cent of the depreciated value. But the *net* addition to plant account, after depreciation and other credits have been deducted, is only $34,994, or 1.6 per cent. This is the figure comparable with the 5.3 per cent *net* increase in the case of the companies, and is relatively only 30 per cent as high as the latter, and absolutely only 13.1 per cent as great. To be sure, if the rate of depreciation written off had been as low in the municipalities as in the companies, this net increase would have been probably from $50,000 to $60,000 higher, or perhaps about 4 per cent of the depreciated plant account. But this would not be an accurate comparison, for under these circumstances we should have to compare the addition with a theoretical investment in plant which had been depreciated at the same rate as the company plants.

The amount *actually* charged to construction accounts during the year, exclusive of any payments from depreciation fund, was in the municipal plants $80,098. This is the addition which appears in the "total plant cost," and should probably be further increased by about

$12,000 which was used for construction out of earnings (not including Holyoke, of course). Thus the additions during the year would be about $92,000, or 3.2 per cent of the total investment. But it must be remembered that no depreciation has in this case been written off. The figure most nearly comparable in the case of the companies would be the gross additions to plant account ($406,795) less the total depreciation written off ($49,232),[1] or $357,563, which is 7.3 per cent of the total investment at the beginning of the year. Reckoned in this manner, the addition to municipal plants during the year would be absolutely only 26 per cent as great as the additions to private plants, and relatively only 44 per cent as great. Finally, the average annual increase in municipal plant investment during the past five years has been $117,398, while the increase in total plant cost for 1914–15, as carried on the books ($80,098), was 32 per cent less than this amount. All of these data simply confirm the above demonstrated fact that the public plants are following a very conservative policy in comparison with the companies. Since the additions during the year were relatively less than the five year average annual additions by an almost equal ratio in both groups of plants, it is probably safe to assume that the abnormal market conditions were responsible for the decrease.

Brief mention should be made of the balance sheets of the two groups. The 12 municipal generating plants in operation in 1897 (the first year when the data are clearly available) showed a net deficit of $82,558. In 1900 the deficit had become $172,833 for 14 plants, and in five years more it had grown to $338,955 for the 18 generating

[1] The amount of depreciation *written off* in a given year by a group of companies does not necessarily coincide with the actual *charges* for depreciation during the same period. This is due to the fact that some plants carry their depreciation under liabilities, as a *reserve*, frequently invested in the business, and do not, therefore, reduce their capital accounts.

plants under consideration. By 1910, however, the net deficit had been reduced to a total of $281,796, excluding Holyoke. Of the 17 plants at this date 5 report a surplus of $78,926 and 12 a deficit of $360,722. In 1915, 8 report a surplus of $181,210, while 9 show a deficit of $236,469, so that the net deficit is reduced to $55,259.[1] Holyoke, with a little surplus of $6,254 in 1910, now boasts a surplus of $401,419, apparently due to the fact that a good share of its maturing indebtedness has been paid off out of earnings. This has also occurred on a very small scale in two or three other plants.

The relatively rapid growth in the size of the net deficit after 1900 was partially occasioned by the scrapping of some of the now antiquated equipment which had been taken over a few years previously from private owners — a kind of depreciation with which many municipalizers have failed to reckon, and which makes the annual rate of depreciation difficult to standardize. Part of the deficit, also, has been the result of inefficient financial management. The figures in general indicate that the municipal plants are beginning to find their financial feet, largely through a policy of ultra-conservatism during the past few years. As a number of them cease to generate current, however, as is the present tendency, they will find themselves burdened with a large amount of "dead" assets, against which they have to date been able to make no provision.[2] Had the public plants received an income from street lighting, they might now show an appreciable surplus since they have no taxes to pay, and are relieved of numerous other expenses. This, however, would not be a *true* surplus, as will presently be made clear.[3]

Of the 17 companies studied, 15 show a surplus of

[1] In the case of composite plants the surplus or deficit has been roughly divided according to the ratio which the total cost of the gas plant bears to the total cost of the electric plant.

[2] Cf. ch. XI, pp. 320–321.

[3] Cf. ch. VII.

$800,528, a growth of 52.3 per cent over their 1910 surplus of $525,734. While 2 of the smaller plants (Buzzard's Bay and Vineyard) reported a negligible deficit at both dates, the net surplus for the group is equal to 15 per cent of the entire investment. This is a remarkably good showing as compared with the public plants, and would seem to indicate that, as so goodly a surplus has been built up out of earnings, the financial management of the companies has been all that could reasonably be desired, even though in some cases it may not have been ideal.

As to the methods of financing their business, it appears that the 12 companies doing a purely electric business have 59.5 per cent of their total capital and loan liabilities ($3,563,964) in the form of stock, 20.1 per cent in notes, 17.7 per cent in bonds, and 2.7 per cent is represented by premiums realized from the sale of capital stock. The *outstanding* indebtedness of the 14 similar municipal plants ($1,351,682) consists of 82.2 per cent bonds and 17.8 per cent notes.

Finally, while the aggregate indebtedness of the municipal plants has increased 10.9 per cent during the past five years, the ratio which this bears to the total investment has actually decreased from 60.3 per cent to 53.4 per cent. This is accounted for by the fact that a considerable portion of the bonds and notes have been paid off by means of appropriations from the tax levy, and in a few cases, as suggested above, by payments from earnings. The *per capita* indebtedness has remained practically constant ($7.85) during the period, and the ratio which the indebtedness bears to the total municipal indebtedness, for all purposes (16.3 per cent), has also been subject to little change during the period.

It is sufficiently obvious that few risks are now being taken by the municipalities. The public lighting business appears to have been in a relatively quiescent state during the past few years. It is highly probable, however, that

within the next period of 5 to 10 years there will be a rapid debt expansion, occasioned by the necessity of bringing the equipment up to date and meeting the needs of new business; or, in lieu of that, there may be a general scrapping of generating plant, and a resort to the use of purchased current wherever possible.

Summary

The more important findings of the present chapter may be briefly summarized as follows:

1. Because of the lack of uniformity and the unsatisfactory character of the prescribed accounting methods, it is difficult to get wholly comparable investment figures. Those chosen, however, will if anything tend to put the companies at a disadvantage in relation to the public plants.

2. It is evident that the investment in the private plants has increased much more rapidly during the five-year period than has that of the municipal plants.

3. This more rapid increase in investment is readily and fully accounted for, however, by the growth of underground construction in the former, by the far more rapid increase in length of lines, the installation of a proportionately greater number of poles, the greater increase in the size of generating units, the more rapid increase in number of customers and in street lights, etc.

4. Though the investment per kilowatt capacity of dynamos is considerably greater for the companies, this is explained by some of the reasons just mentioned, as well as by the fact that their investment in real estate is much higher relatively than that of the other group, due to more adequate stations, etc. In fact a number of the municipal plants carry no account for land, as it is owned by the municipality, and many of their buildings have been found to be highly unsatisfactory.

5. The public plants, in spite of the fact that they are

purchasing relatively more current than are the other group, have been increasing their station investment far more rapidly than their line investment, while the opposite has taken place in the companies. But, since the former have been shown to lag behind the growth of the community rather than to lead, it would appear that we have another evidence of an undue attempt to restrict the extension of service only to the more promising customers.

6. The earlier deficits of the municipal plants are being gradually wiped out, largely as a result of the advantage gained from relatively more favorable territory, and due also to an unmistakable policy of *great* conservatism. The companies, on the other hand, though they have taken greater chances, have been constantly building up their surplus.

7. Holyoke, in the matter of investment, does not, in the main, seem to have any noticeable advantage, particularly if due allowance be made for size and for the compact nature of the territory served. As it will appear later, also, there is now need of a *greatly increased* investment in station.

CHAPTER VI

FINANCIAL STATISTICS OF GENERATING PLANTS (*continued*)

Operating Expenses and Operating Income

The point has now been reached at which most students of the subject of municipal electric lighting *begin* the superficial investigations which lead to their hasty conclusions. To the writer, however, the vital issues appear to lie much too deep to be discovered and decided by a mere examination of the income and expense accounts together with a few vague generalizations about rates. As the most *obvious* function of public service commissions is that of rate regulation, the public and the average student usually over-emphasize this one aspect of the problem, forgetting, or, rather, not even surmising, that back of all this specious analysis are a myriad of considerations, some of them highly technical and others more general, which must constantly be borne in mind if regulation is to be anything more than blind restriction or futile interference.

The investigator who attempts to decide the case for or against municipal ownership by the elementary study of the charge for service and its apparent cost under public operation as compared with that of similar service rendered by private enterprise, is accomplishing little more than the man who would commit suicide by shooting at his reflection in a mirror. The one who compares the existing rates under municipal ownership with the rates which *might have been* or *were* under private ownership, and so makes out his case for one side or the other, is usually wasting his time. With regulation such as we find in Massachusetts, as well as in many other States at the present

time, it is generally possible for the *people* to secure their full pound of flesh from any public service corporation whatever, provided they avail themselves of their rights. Hence we are primarily concerned with what *is*, in the matter of rates and costs, and with what *has been* and *will be*, in the matter of physical equipment and extension and conduct of service.

Nevertheless, since a reasonable perspective has now been developed, it will be worth our while to give some attention to the methods and results of operation of our groups of plants during the year 1914–15, with occasional reference to the year 1909–10. Before discussing the price paid for service let us, accordingly, analyze the cost of that service.

1. Unit Costs[1]

The total operating expenses of the companies per kilowatt hour delivered[2] decreased 18.6 per cent, from 4.386 cents in 1910 to 3.572 cents in 1915, while the expenses of the public plants (Holyoke excluded), decreased from 4.340 to 3.766 cents, or 13.2 per cent.[3] To the casual observer this might seem to indicate that the conditions are about the same in the two groups, and that the public plants, in view of their smaller size, are making a relatively better showing. And, indeed, they do give a reasonably good account of themselves.

If, however, the taxes paid by the companies be deducted, in order to remove one of the most obvious addi-

[1] Appendix, pp. 432–441, 446–447.

[2] "Delivered" means "sold" in the case of the companies and in reference to the public plants it includes current used for street lighting as well as current sold to commercial customers. Sometimes, however, the word "sold" is used indiscriminately in both cases to include all current "delivered" to consumers, whether public or private.

[3] The cost per kilowatt hour is always given in cents or decimals thereof; but it hardly seems necessary to repeat the word "cents" each time the figures are given. Likewise the expression "unit cost" will ordinarily be used instead of the phrase "cost per kilowatt hour."

tional expenses which the companies incur, since municipal plants are not taxed, the unit costs for the former become 4.100 in 1910 and 3.144 at the end of five years — a decrease of 24 per cent.[1] In other words, the unit operating expenses of the municipal plants were, in 1910, about 6 per cent higher than in the case of the companies, and, in 1915, *nearly* 20 *per cent higher*. While there has been a decrease in both cases, it has been almost twice as rapid for the private plants. If we should go further and deduct the salaries of corporation officials (0.197 per kilowatt hour sold), an item which does not appear in the municipal expenses, the unit cost of the companies would decrease to 2.947, while the public plants would show a figure 28 per cent higher. In order to put the two groups on an absolutely equal basis for the purpose of studying their *operating efficiency*, we would have to eliminate a number of other items in the case of the companies and make several additions in the case of the municipalities. But of this more anon.

Now, to be sure, some allowance should be made for the fact that the companies deliver considerably more current than the other group. Yet there is not necessarily much difference between the total unit costs of a plant doing a 900,000 kilowatt hour business annually and one doing a 1,400,000 kilowatt hour business. We would expect a far greater difference to be found between a plant which delivers 500,000 hours and one which delivers 900,000 hours. However, the public plants, which increased their business from a little more than 500,000 hours in 1910 to nearly 900,000 hours at the end of five years reduced their unit costs only 13.2 per cent, while the companies, increasing their current sold from 900,000 to about 1,400,000 kilowatt hours, reduced their costs by 24 per cent, or 18.6 per cent if the taxes be not deducted at both dates.

[1] The unit cost for taxes increased from 0.286 in 1910 to 0.428 in 1915, a proportionate growth of 50 per cent!

The fact that the two groups stood so close together in 1910, in spite of the difference in size, so far as the writer has been able to investigate, seems to speak well for the public plants, and *prima facie* it might be said that the companies were not being operated as efficiently as they should be. But the wide spread between the two at the present time, when only the taxes paid are eliminated, seems more difficult to justify. Part of the comparative improvement is a result of the decreased amount of current unaccounted for in the companies and the correspondingly increased amount in the case of the public plants. It is also the result of more businesslike methods of operation along other lines. We must, however, analyze the different items entering into the expense accounts before attempting to draw definite conclusions.

TABLE 26. OPERATING EXPENSES PER K.W.H. DELIVERED (1914–1915)

Class of expense	*(1) Companies (cents)*	*(2) Municipalities (cents)* [1]	*Per cent by which (2) exceeds (1)*
Total	3.572	3.766	5.4
Taxes	0.428	...	...
Salaries of officers	0.197	...	...
Total — taxes deducted	3.144	3.766	20.0
Total — taxes and salaries of officers out	2.947	3.766	24.0
Cost of distribution	0.648	0.782	20.7
Cost of manufacturing (per K.W.H. made)	1.376	1.829	33.0
Labor at station (per K.W.H. made)	0.408	0.626	53.0
Fuel of every kind (per K.W.H. made)	(14) 0.808	(17) 0.915	13.2
Coal (per K.W.H. made)	(12) 0.742	(15) 0.933	26.0
K.W.H. generated per plant	1,650,091	1,024,023	—37.9
K.W.H. delivered per plant	1,437,544	881,914	—38.8
K.W.H. delivered (street lighting out)	1,232,050	670,276	—45.6
Operating expenses (dollars)	$872,935	$562,643	—35.5

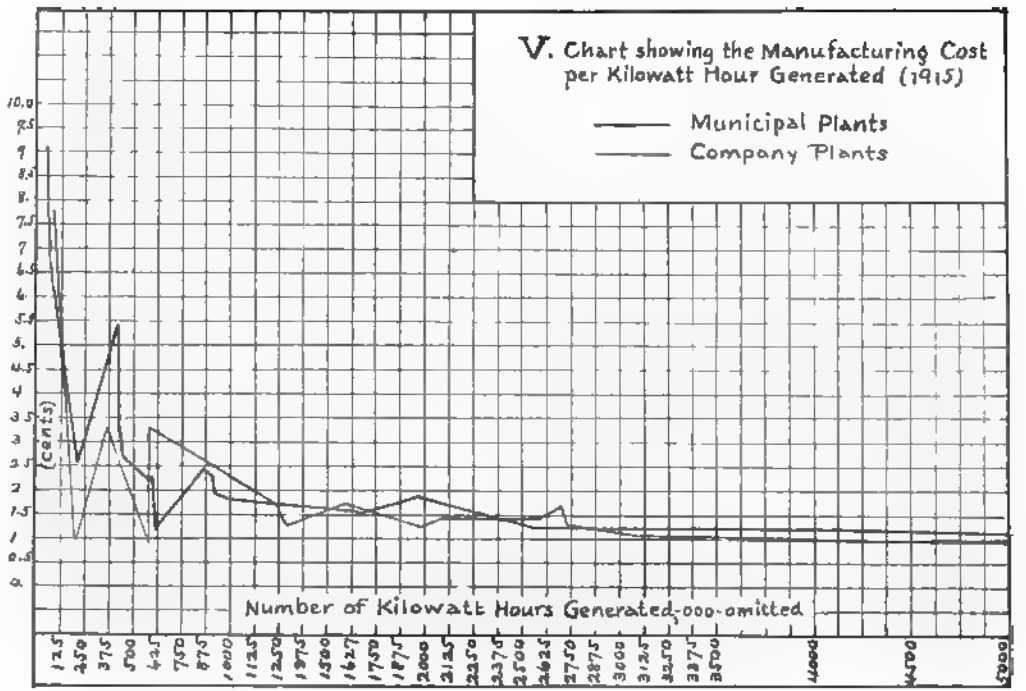
[1] Holyoke omitted here as elsewhere.

Table 26 presents in a concise way some of the general relations which the operating costs in the two groups bear to each other. It is significant to note that in all of the important items the companies show a greater economy in operation. Reference will from time to time be made to these relations.

To begin with the manufacturing costs,[1] we find that the graphs are surprisingly parallel for the two groups, though the unit cost of the public plants (1.829) is 33 per cent higher than that of the companies (1.376). In each case, three of the plants generating less than 600,000 kilowatt hours are abnormal — two are unusually low, due to the fact that water power or oil is used instead of coal, and one is unusually high. Were these plants eliminated, the curves would be fairly close together, with the companies usually running somewhat lower. If the one extreme case of Buzzard's Bay were left out, the curve would be markedly lower for the companies generating less than 1,000,000 hours than for the corresponding municipal plants. For plants with an output between 1,000,000 and 2,500,000 hours there seems to be little evidence of decreasing costs because of increasing size in either group. This tendency is most marked for plants having under 500,000 kilowatt hours output, although it is plainly to be seen till the 1,000,000 size is reached.

Excluding Holyoke, one of the municipal plants, Middleborough, uses some gas and a good deal of water for generation of current, and Mansfield uses nothing but fuel oil. Hence these must be eliminated if we wish to secure comparable data for fuel costs. Of the companies, likewise, three generated what little current they made by means of water power wholly, and so must be left out, together with two others, one of which used a consider-

[1] The "manufacturing" cost, as required in the returns, covers all the expenses "at station" connected with the making of current, including rentals, repairs, and maintenance of plant.


V. Chart showing the Manufacturing Cost per Kilowatt Hour Generated (1915)
Municipal Plants
Company Plants
(cents)
Number of Kilowatt Hours Generated, 000 omitted

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able proportion of oil and the other some water wheels. Having made these adjustments, we find the cost of coal to be 0.742 for the 12 companies, and 0.933, or 26 per cent higher for the 15 public plants. If all fuel of every kind, as well as water power rentals, be included, the averages are 0.808 for 14 of the former, and 0.915, or 13.2 per cent higher for 17 of the latter. The fuel cost amounts in the one case to 58.6 per cent of the total manufacturing expenses, and in the other case to 50 per cent.

The chart includes the fuel costs of all plants reporting this item. The two low points on the municipal plant graph between 400,000 and 600,000 are accounted for by the two plants above referred to, using oil and mostly water. If these are eliminated, as, of course, they should be, the curve would conform much more closely to that of the companies for plants having less than 1,000,000 kilowatt hours output. As the three small plants of the latter group, which use only water power, do not appear in the graph, the number of cases taken is so small that it is futile to attempt any comparisons at this point. For the larger plants, however, with the noticeable exception of Weymouth, the companies all show a considerably lower fuel cost than the public plants.

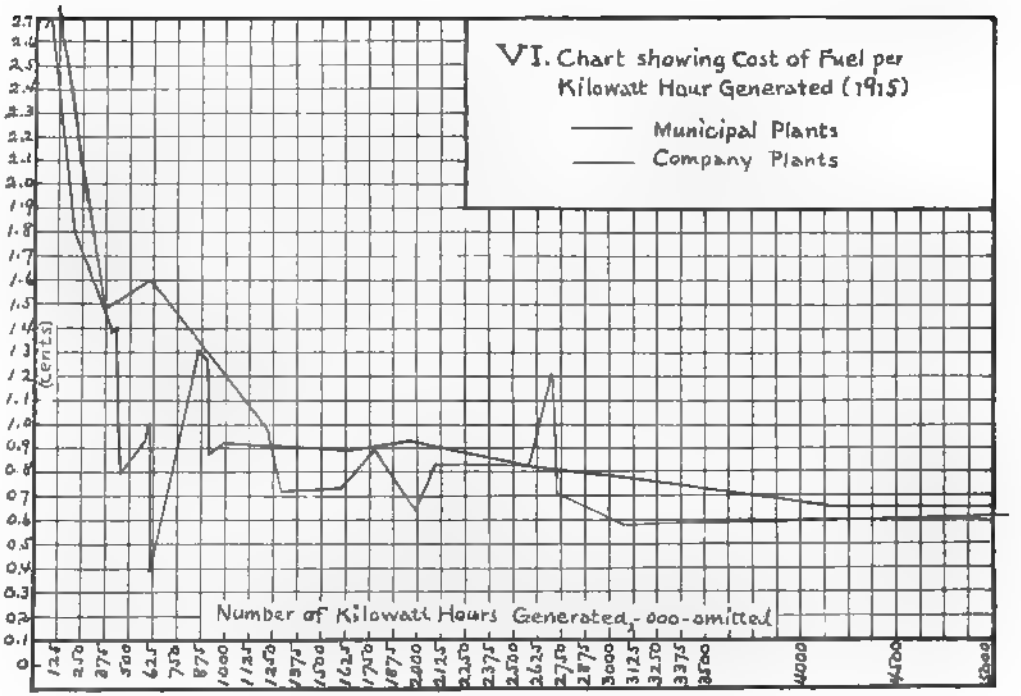
According to an earlier chart the private plants have, on the average, some advantage in the number of watts generated per pound of coal, or, expressed differently, they are using about 15 per cent less coal per kilowatt hour (4 pounds) than are the municipal plants (4.690 pounds). They also appear to be getting their coal for a somewhat lower price per ton than the other group, $4.15 for the 12 companies as opposed to $4.46, or 7.4 per cent more, for the public plants. (If *all* of the coal bought by the two groups is included, the excess of cost for the public plants becomes only 5 per cent — $4.46 as against $4.25 for the other group). But, when we compare this excess in price paid per ton with the excess in unit costs (26 per cent),

we can see clearly what was not altogether evident in the former chapter, that it must be a question of appreciably better fuel economy in the companies, secured by the more liberal use of economic appliances and by the exercise of greater care, for the load factors of the larger plants are about the same in either case, and yet these are the ones which show the widest divergence in cost for this item. Nor does it seem that there is any particular tendency toward decreasing unit costs of fuel for plants ranging in output from 1,000,000 to about 2,500,000 kilowatt hours. Consequently the advantage possessed by the private plants can scarcely be attributed to mere size.

In this connection attention must be called to the surprising fact that Holyoke, notwithstanding its size, and even though it uses some water power, is surpassed in fuel economy, according to this unit cost analysis, by one other public plant, and by three private plants. Its cost, including water power rental, is 0.669, while that of Taunton is 0.664. Of the other group Plymouth shows a cost of 0.646, *though it is one seventh the size of Holyoke*, North Adams, 0.618, and Attleborough, 0.581.

The other important item in the manufacturing expenses, "wages at station," presents some interesting relations. In the first place, while it constituted 30 per cent of the total station costs in the case of the companies, and 34.2 per cent in the municipalities, its unit cost was relatively 53 per cent higher in the latter than in the former. This is really a surprisingly large difference. To be sure, the number of pounds of coal handled per kilowatt hour generated is from 12 to 15 per cent greater in the public plants, and a rough relation might be expected to exist between the station wages and the amount of coal consumed. This, however, would not be enough to account for the divergence.

Upon an examination of the accompanying graphs, it becomes sufficiently obvious that, while there is a close


VI. Chart showing Cost of Fuel per Kilowatt Hour Generated (1915)
Municipal Plants
Company Plants
(Cents)
Number of Kilowatt Hours Generated - 000 - omitted

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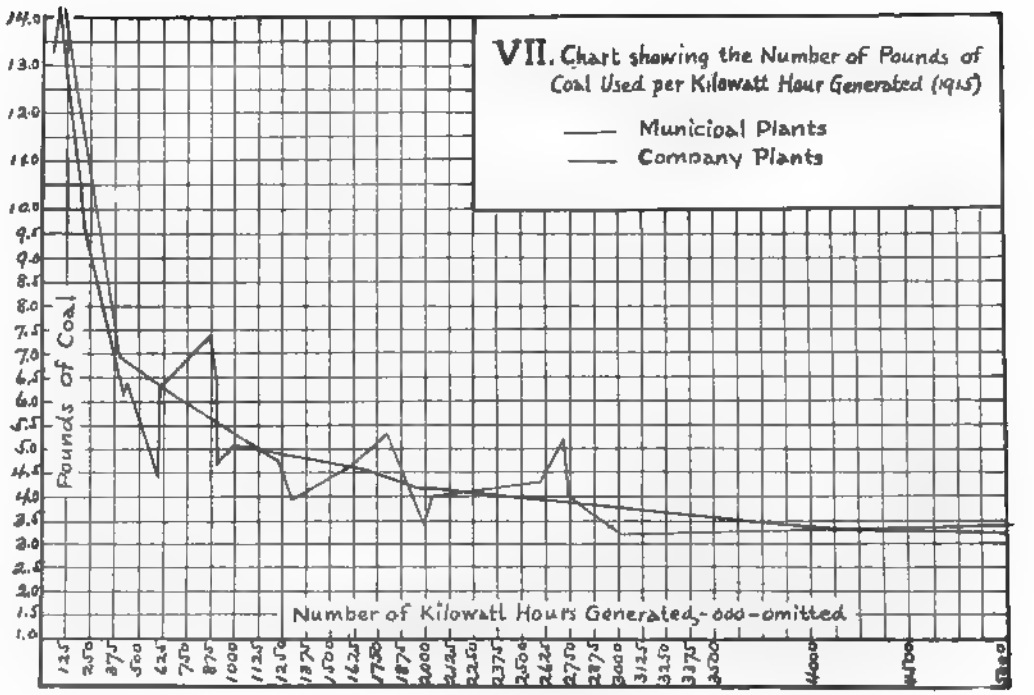
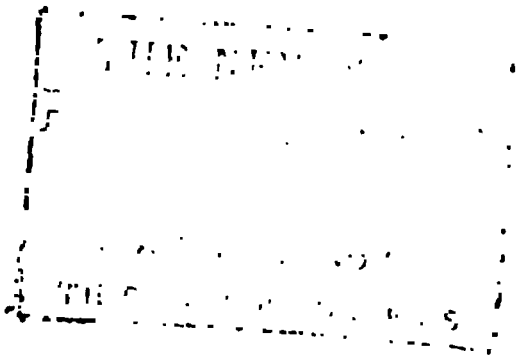

VII. Chart showing the Number of Pounds of Coal Used per Kilowatt Hour Generated (1915)
Municipal Plants
Company Plants
Pounds of Coal
Number of Kilowatt Hours Generated,-000-omitted



correspondence between the unit costs for labor in both groups for plants generating more than 1,000,000 kilowatt hours, the companies under this size have a decided advantage over the municipal plants. If the one extreme case of Buzzard's Bay be omitted, the graph for the private plants runs invariably much lower at this stage. On the other hand, if the three companies generating by means of water power be left out, though they are too small to have any noticeable effect upon the averages, the curves would not be so far apart. But the company graph would still run lower, particularly when we eliminate the oil using plant of Mansfield, and Merrimac, which probably secures some unaccounted for labor from the water department, perhaps included in the item "rent of station."

Upon the whole it appears that the chief reason for the higher station wages of the public plants is due to the fact that so large a proportion of them are smaller than the companies, and, with two exceptions, are all using coal for generation, while three of the smaller companies use water power, and thus keep this cost item comparatively low. Yet, in several instances, the graph runs unreasonably high for the public plants. The eight-hour municipal day, possibly higher wages, — the companies do not return the rate of wages which they pay, — and the slightly poorer load factor of the latter, may further help to explain the difference, without recourse to the time-honored and threadbare argument that public labor is less efficient than private labor.[1] Finally, since the station wages of the larger plants in both groups are, for the most part, not far apart, it would not appear that there has been a greater utilization of labor-saving devices by one than by the other.

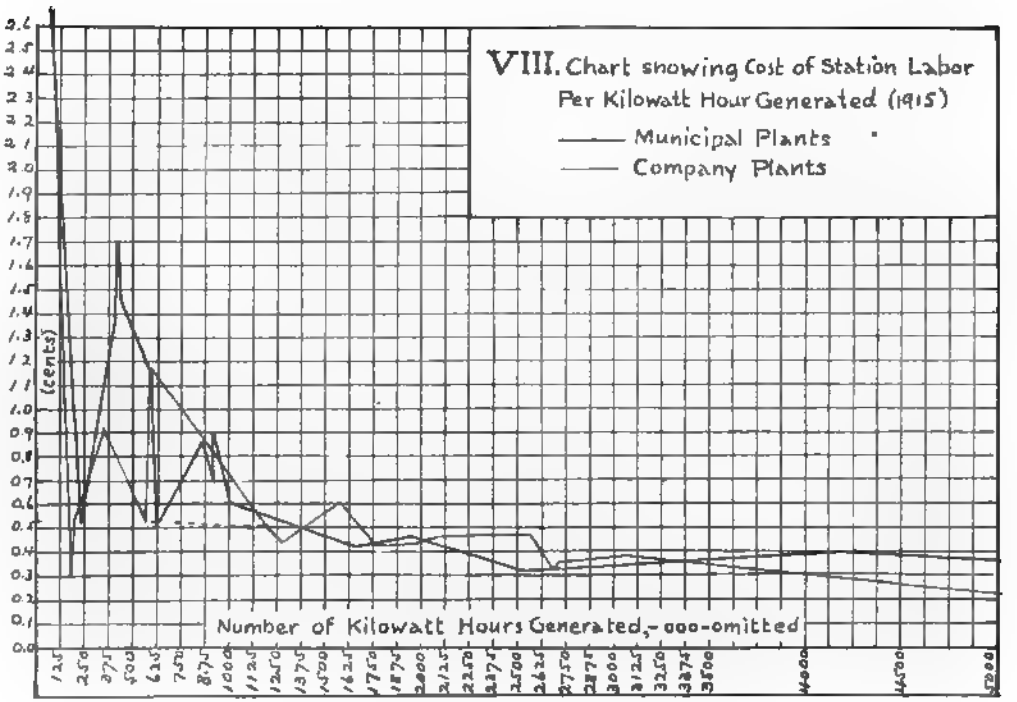
Of the remaining items entering into the manufacturing expenses, little need be said. It appears that the public plants are, with two exceptions, paying for the water

[1] The local survey, however, has convinced the writer that there is a good deal of truth in the "efficiency" argument.

which they use, though at a somewhat lower rate than is paid by the other group (0.029 as compared with 0.035), due to the fact that the municipalities seem to be making their electric plants a lower rate than is customary. Their expenses for oil and waste (0.032) are 60 per cent higher than the companies incur (0.019), and for distribution tools and appliances they are spending three times as much as the latter (0.032 as opposed to 0.012). The difference in the first case is probably largely the result of the economies which arise from greater output of current per plant, while in the second case it seems to be partially waste. For repairs of all kinds at station ("station structure, steam plant, and electric plant"), the apparently higher cost of the municipal plants is mostly accounted for by the fact that Hull charged the installation of a new boiler to the operating accounts. With this anomaly eliminated, the items are not far apart, 0.141 for the public plants and 0.115 for the companies. The difference can probably be accounted for by the greater output of the latter. The current purchased costs about the same in both cases, 1.500 in the former and 1.636 in the latter.

The expenses of "distribution," as returned to the Board, are too indefinite to lend themselves to any conclusive analysis. The accounts are not similarly kept by the two groups,[1] and many of the individual returns are open to serious question. In the first place, the wage item for the companies is supposed to include "wages for care of lights, meters and motors, meter reading, clerical labor, and salary or commission of collectors." In the municipal returns the directions are very vague on this point — "wages for care of lights, meters, clerical labor, etc.," with probably a good deal of emphasis on the *et cetera*. Wages of linemen are supposed to be entered, not here, but under "repairs and renewals of lines." In the case of the companies, however, these wages were formerly en-

[1] Since 1915 there has been some improvement in this regard.


VIII. Chart showing Cost of Station Labor
Per Kilowatt Hour Generated (1915)
Municipal Plants
Company Plants
(cents)
Number of Kilowatt Hours Generated,-000-omitted

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tered under the general item of distribution wages, and probably some of them still follow this policy, and so cause their "wages" to appear unduly large and their "repairs and renewals of lines" abnormally small. But, in practice, there seems to be much overlapping in the case of the wages reported, particularly in the smaller plants. Some of the employees are doubtless "jacks of all trades," and, from station expenses to general office expenses, it is largely a matter of chance where their wages shall appear and how the distribution shall be made.

In 1915, for the first time, the companies were required to keep the "maintenance and renewals of street lamps separate from that of commercial lamps, and a separation is also made between "repairs and renewals of lines and conduits," and "repairs and renewals of meters and transformers." The municipalities, on the other hand, are required to make no such separations. They return only the items of "repairs of lines, arc lamps, and meters," which corresponds only roughly to the two items just mentioned for the companies, and "incandescent lamps," which includes both municipal and commercial lamp maintenance and renewals, though the arcs appear in the preceding entry. About the only thing to do under the circumstances, is to group together all of the items of repair and renewals or maintenance in each case, as the writer has done in the table appended. There is absolutely no way of discovering how much of the aggregate expense is maintenance and how much is renewal. Nor can anything more than the roughest guess be made as to how much of the cost is due to material and how much to labor.

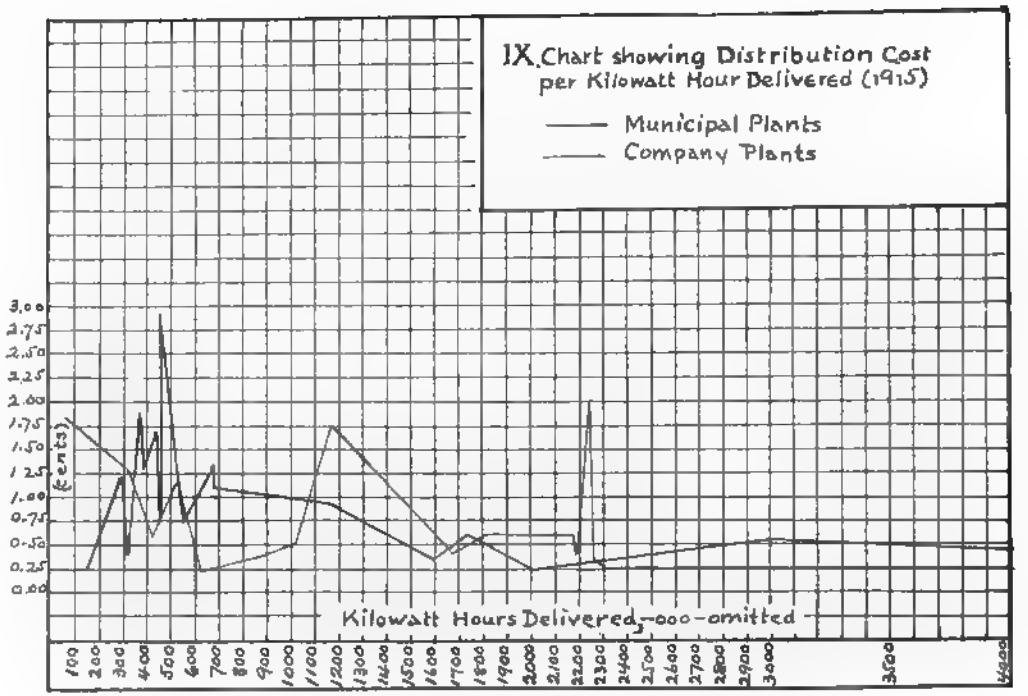
Bearing in mind the uncertainties involved, we note that the reported wages are 26.5 per cent higher for the companies (0.181) than for the municipal plants (0.143). But, as has been suggested, probably some of the linemen's wages are here included by the former, and it may be that the latter report elsewhere wages which should be entered

here. One municipal plant, Merrimac, reports no distribution wages whatever. The individual anomalies are so numerous that it would be hopeless to try to account for them, except that it may be generally stated that when the commercial and street lighting business is proportionately large, the wages are found to be higher.

For distribution tools and equipment, it also appears that the public plants are paying about 50 per cent more than the companies. There seems to be no rule or reason for the anomalies which here present themselves.

The expenses for repairs and renewals of all kinds run 30 per cent higher for the municipal plants (0.494 as opposed to 0.375). This seems to be a rather large difference in view of the fact that the municipal plant lines are not so widely extended as those of the companies, and that they do not have relatively so many poles to look after. But, as suggested above, perhaps a greater proportion of wages is entered here. The advantages which the companies have can be accounted for partially by the fact that, in view of their recent rapid extensions, their distribution equipment is comparatively much newer than that of the other group, and partially to the fact that not all of their linemen's wages are reported in this item. In this case the underground construction, while highly important for the individual plants, does not seem to have much influence in reducing the expenses, since it is found principally in only two plants, and, strange to say, one of these, Gloucester, reports a unit cost (0.891) more than double the average for the group.

Probably this is one of the instances in which the public plants are not so highly favored as far as their labor costs are concerned. This is a more highly specialized kind of work, and it would be rather difficult to combine the duties of a clerk or day laborer with those of a lineman. Hence there is doubtless less overlapping here than elsewhere. Furthermore, experience and observation teach us that


IX. Chart showing Distribution Cost per Kilowatt Hour Delivered (1915)
Municipal Plants
Company Plants
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
(cents)
Kilowatt Hours Delivered,-000-omitted
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
2400
2500
2600
2700
2800
2900
3000
3500
4000

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municipal employees who have work to do along the public highways, whether it be repairing lines, setting poles, transplanting trees, or even shovelling dirt, are particularly prone to soldier on the job. Difference in size of plants would play little if any part in this item, for there is a fairly close relation between the extent of the distribution system and the amount of current delivered. Countless local considerations may affect the situation. It is true also that, in some cases, because of more careless initial installation the municipal plants now find it necessary to expend more on repairs. Definite conclusions could be drawn only after a careful study of this item over a period of years. The year taken may not be typical.

The distribution cost graph of the companies, with the exception of Gloucester and Quincy, which do primarily a lighting business, runs for the most part lower than the municipal plant graph at all stages, but the difference is most noticeable for the smaller plants. Mere size of plant and extent of business seem not to enter into the differences which here exist, unless in an indirect way.

Among the expenses which the writer has classified as "management and miscellaneous," the item of "general salaries" seems to include the wages of most of the "soft handed" employees as well as the salaries of the municipal managers. This cost appears to be almost twice as high in the municipal plants (0.270) as in the companies (0.146). The difference may be in some measure due to the fact that the latter are larger, for the necessary number of salaried employees does not change greatly, even with a considerable increase in amount of current sold. Furthermore, there may be inaccuracy in the returns, — some of the salaries belonging here are perhaps hidden in the "general office expenses" of the companies which are comparatively high. On the other hand, the public plants have probably entered under this head some of the wages which should have been included in distribution wages,

which, it will be recalled, were unexpectedly low. There might also be a certain number of municipal employees serving as ornaments and thus padding the pay rolls. And, finally, some of the corporation officials are doing work which would ordinarily be performed by salaried employees.

It is instructive to observe that the "officers' salaries" of the companies (0.197) exceeds the "general salaries" by 35 per cent, and that the sum of these two, 0.343, is 27 per cent higher than the "general salaries" of the public plants. Also, salaries of the municipal light boards (0.022), of which 12 are receiving some remuneration, exactly coincide with the allowances for directors of the companies.

The general office expenses are, as has been suggested, 70 per cent higher in the companies (0.230) than in the other group (0.135). This difference may be due (*a*) to inaccuracy in entering the wage items in the returns, (*b*) to wasteful expenditure on the part of the companies, and (*c*) probably in large measure to the fact that many of the companies do a good deal of advertising and soliciting of new business, whereas the public plants rarely indulge in this form of expense.

It must be further noted in considering this question that a number of the public plants have their offices in municipal buildings, for which they pay no rent. The total amount of office rental paid by them is only 0.007, while that paid by the companies is 0.034. This, to be sure, is a very small item; but occasionally some of the public plants also receive other free service along with this free room, which will help to keep the office expenses low.

Only three municipal plants, besides Holyoke, report any auditor's fees. And, since no charge to this account could well be hidden in the general office expenses, which run so low, there is good presumptive evidence that a number of the plants receive free service from the municipal auditor or accountant, as is the customary procedure.[1] In like

[1] This presumption was fully confirmed in the local survey.

manner the law expenses, which amount to 0.019 in the companies, are almost too small to be recorded in the other group. While this may mean that there *are* no legal expenses in the latter, it may also indicate that the services of the city solicitor are utilized *gratis*. No note seems ever to be made of the fact that the town or city treasurer contributes a great deal of valuable time to the business of handling the funds and loans of the municipal plants. In the companies a good deal of such work would be given over to a high salaried officer.

In the matter of bad debts there seems to be little to choose between the two groups, and the insurance charges are also about the same. The taxes paid by the companies, 0.428, seem to bear absolutely no relation to the amount of investment in plant or the extent of business done. The lowest unit cost for this item is found in two of the smaller plants, Lee (0.116) and Buzzard's Bay (0.147); but the next lowest cost is that of North Adams (0.171), which has the largest output of all. On the other hand, the smallest plant of the group, Citizens', shows the highest expenditure for taxes per kilowatt hour delivered, 1.205, and one of the largest plants, Beverly, comes next with an expense of 0.849 under this head.

So far as the total operating costs are concerned, there is little correspondence between the graphs of the two groups. When, however, we eliminate the two extremely high companies, Gloucester and Quincy, and the two abnormally low ones, Lee and Winchendon, as well as the extraordinarily high municipal plant of Hull, the curves come reasonably close together, with the companies having only a slight advantage under 1,000,000 and a considerable disadvantage from that point to 3,000,000. The latter appear to make no remarkable showing, particularly in the case of the larger plants.

Now, in view of the considerably lower costs of manufacture and distribution, it is evident that the higher man-

agement and miscellaneous expenses (1.548 as contrasted with 1.155 in the public plants), are responsible for the fact that the companies have on the average so slight an advantage (3.572) over the municipal plants (3.766). Nor is this higher cost at this point the result of an excess expenditure of the former over the latter in items common to both. It is rather accounted for by additional expenses not found in the returns of the public plants. The effect of taxes and salaries of officers has already been referred to. In addition, higher office expenses, though probably justified, higher legal expenses, higher rentals, all unite to make the showing of the companies worse in comparison with the municipal plants.

When the more obvious deductions are made so that we can compare the operating efficiency of the two groups, we find that while the management and miscellaneous expenses run somewhat lower for the companies (0.923) than for the other group (1.155), the difference is not much more than would be expected as a result of their greater size. The very fact that they are private concerns renders it necessary for them to incur some expenses which municipal plants, by reason of their public ownership, would not be subject to.

Furthermore, the law of decreasing costs, which appears to assert itself in the routine part of the business, particularly in the generation of current, is of rather doubtful application with regard to the important items entering into the miscellaneous expenses, including taxes.

Upon the whole, however, the writer does not feel that the companies, in spite of their apparently better physical development, have done so well in their actual operation as might have been expected under more efficient management and less "control." The municipal plants, on the contrary, seem in general to have been operated with a higher degree of efficiency than might be expected.

So far as Holyoke is concerned, the writer does not

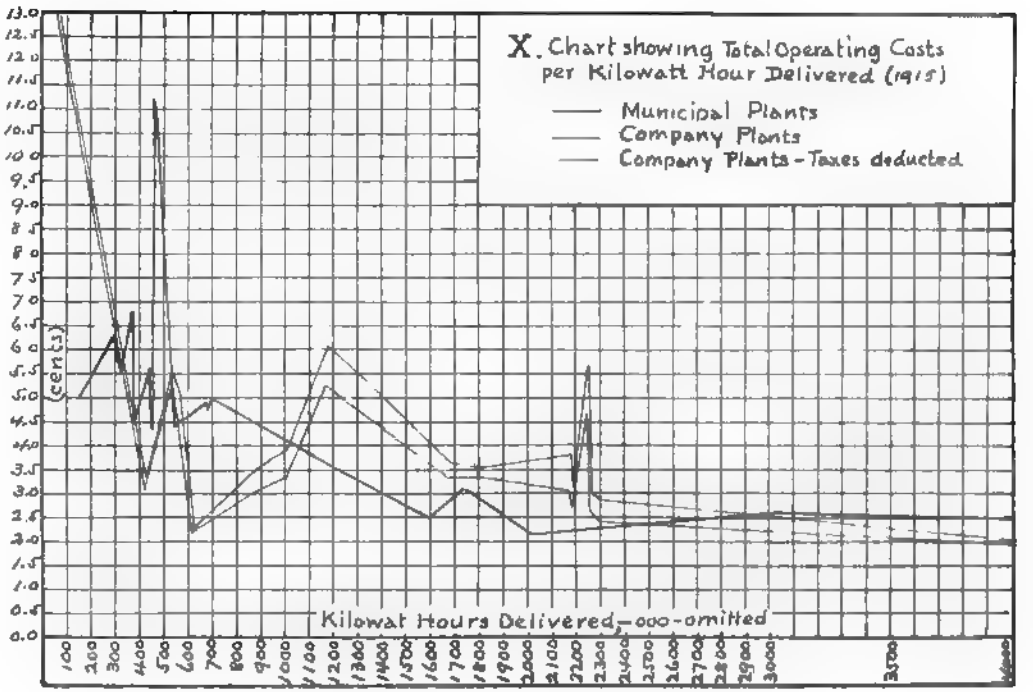
X. Chart showing Total Operating Costs per Kilowatt Hour Delivered (1915)
Municipal Plants
Company Plants
Company Plants - Taxes deducted
(cents)
Kilowat Hours Delivered, -000- omitted

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TABLE 27. PERCENTAGE ANALYSIS OF EXPENSES (GENERATING PLANTS)

Kind of expense	Companies		Municipalities		Holyoke
	Amount	Per cent of total	Amount	Per cent of total	Per cent of total
I. Operating expenses — General analysis.					
Manufacture	$386,109	44.4	$308,937[1]	55.8	70.7
Purchase of current	30,239	3.5	35,491	6.4	...
Distribution	158,465	18.2	117,794	21.3	16.9
Office expenses and management	153,755	17.6	65,428	11.9	11.5
Miscellaneous	39,776	4.5	25,596	4.6	1.7
Taxes	104,591	12.0	...	...	...
Total	$872,935		$553,246		
Total — taxes deducted	$768,344				
II. Operating expenses — Detailed analysis (taxes out)					
Fuel	$220,204	28.7	$158,648	28.7	49.8
Wages at station	114,590	14.9	109,048	19.7	16.2
Repairs at station	32,244	4.2	24,563[1]	4.4	3.7
Current purchased	30,239	4.0	35,491	6.4	...
Distribution wages	44,236	5.8	21,366	3.9	5.1
Repair of lines	91,633	11.9	74,094	13.4	10.3
Distribution tools and equipment	22,596	2.9	22,328	4.0	1.3
General salaries	35,781	4.7	40,750	7.4	7.7
Salary of officers	48,201	6.3	...	...	...
Directors' allowances	5,388	0.7	...	...	...
Salary of municipal light boards	...	...	3,167	0.6	...
General office expenses	56,158	7.3	20,285	3.7	3.8
Insurance	30,703	4.0	19,507	3.5	1.2
Rent of offices	8,228	1.1	1,120	0.2	...
All other expenses	28,143	3.7	22,879	4.1	1.3
Total	$768,344		$553,246		

[1] Hull, new boiler, $9,397, omitted.

believe that, judging by the statistics, any remarkable showing has been made when we consider the unusually favorable district which this plant serves. No particular effort seems to have been exerted to develop new territory, and the amount of business done in 1914–15 was actually less than in the preceding year.[1]

The accompanying percentage analysis of expenses (Table 27) shows the relation which the more important items discussed bear to each other. It appears that the items of cost other than manufacture, distribution, and purchase of current, constitute a very large proportion of the total outlay of the companies, 34.1 per cent, as compared with only 16.5 per cent for the municipal plants. It is rather surprising to find the proportion spent for fuel, when taxes have been deducted, exactly the same in the two groups. The total expenditure for wages and salaries, including directors' allowances and the salaries of the municipal light boards, is for the companies 32.4 per cent of all outlays, and for the municipalities 31.5 per cent. Taxes and salaries of officers, it will be observed, account for one sixth of the operating expenses of the former.

2. Rates and Income[2]

The public in general are more interested in the prices which they pay for service than in the cost of that service to those who supply it. Too frequently a municipal plant is considered a success simply because its rates are low, and a private plant is condemned because its charges are high. Whether the pressure exerted by customers for the reduction of rates is greater in the case of the former than the latter, it would be difficult to say. Undoubtedly, however, without the proper legal restraints, a publicly owned plant, by virtue of the fact that it can cover up its losses in the tax levy, would be more subject to such influences

[1] In the following year (1915–16), there was a very marked increase.
[2] Appendix, pp. 442–453.

than a private concern. But, with such laws as are found in the state of Massachusetts, it is practically impossible for municipalities to lose money on their electric business as a result of charging too little for the services rendered (*they cannot sell below cost*), provided they conform to the requirements of the statute as discussed in an earlier chapter;[1] nor are they expected to make any considerable profit.[2] On the other hand, it is comparatively easy to force the companies to make such charges as shall leave them only a "fair" return upon a conservative investment.[3] Hence we should not look for any marked differences in rates between the two groups. Accordingly, it appears that while the companies reduced their unit operating expenses 18.6 per cent during the period studied, their total income per kilowatt hour, from the sale of current for all purposes, has decreased 15.7 per cent. The municipal plants, however, while reducing their unit costs by an amount equal to 13.2 per cent, have lowered their average rates 25.3 per cent, or about 60 per cent more rapidly than the former group. But it must be noted that their rates in 1910 were much higher than the company rates, and that the reduction in their average rate has been occasioned almost wholly by the growth of their power business.

Table 28 shows the close correspondence in average rates at the present time. The spread between the total operating income per kilowatt hour sold in each group, is practically negligible. But when the income from other sources than the sale of current, such as steam heating and rentals, if such there be, as well as the street lighting income in the case of the companies, has been deducted, the unit income is found to be 5.461 for the latter, and 6 per cent higher, or 5.786, for the municipal plants. This difference is not noticeably greater than the difference in the unit costs. Finally, if only the income from the com-

[1] P. 45. [2] Mass., 1914, ch. 742, sect. 115. [3] *Ibid.*, sect. 162.

TABLE 28. INCOME PER K.W.H. SOLD (HOLYOKE EXCLUDED)

Item	1910		1915		Per cent decrease	
	Companies (cents)	*Municipalities (cents)*	*Companies (cents)*	*Municipalities (cents)*	*Companies*	*Municipalities*
Total operating income	6.608	7.960	5.800	5.895	15.9	26.0
Total operating income (street lighting out)	6.531	7.960	5.503	5.895	15.7	26.0
Total from sale of current	6.758	7.742	5.764	5.786	14.7	25.3
Total from sale of current (street lighting out)	6.481	7.742	5.461	5.786	15.7	25.3
Commercial light and power	....	....	5.950	5.800	....	....
Commercial lighting[1]	11.774	11.077	10.062	10.305	14.5	7.0
Street lighting	7.675	....	7.575	....	1.3	....
			(7.333)[2]	....	(4.5)[2]	....
Power	3.458	3.615	3.047	2.583	11.9	28.5
Sales to other companies	2.700	3.000	2.418	4.294	10.4	+43.1
Net income	2.522	....	2.227	....	11.7	....
Net income (street lighting out)	0.985	1.091	1.332	0.957	+35.2	12.3
Operating income (dollars)	$958,675	....	$1,417,235	....	+47.5	....
Operating income (street lighting out)	757,293	443,423	1,152,594	671,761	+52.2	+51.5
Net income (dollars)	312,685	....	544,300	....	+74.0	....
Net income (street lighting out)	116,304	62,202	279,658	109,118	+140.8	+75.4
Operating ratio	67.2	....	61.6	....	−8.3	....
Operating ratio (street lighting out)	84.5	86.0	75.0	83.7	−11.2	−2.7

[1] "Commercial" lighting includes all other than street lighting.
[2] Including only companies reporting at both dates.

mercial light and power business be considered, we find that for the companies the average rate is 5.950, and for the public plants 5.800, or 2.5 per cent lower.

Now, in view of the fact that there is comparatively little difference in the nature of the business done by the two groups, and since the companies have been effectively regulated by the Board, we might, as has been suggested, logically expect an approximate equality in rates, provided, however, that both pay taxes, and that the investment per customer, with the resultant fixed charges, is the same. But here we find a conspicuous difference. The public plants pay no taxes, — an item which will be at present overlooked, as their charges for service must,

according to law, be sufficient to cover the maturing debts and the sinking fund payments, — and their investment per customer is far less.

Without attempting to make a separation between the street lighting business and the commercial light and power business we have found that the total plant investment per customer is $162 in the municipal plants and $226, or 40 per cent higher, in the companies. And we have also found that all of this investment is as well accounted for in the one case as in the other. But, when we carry the analysis further, and separate the investment in *distributing* system according to the proportionate relations to the total which the street lighting lines and the commercial lines bear in each group, it is evident that the fully justified investment per customer is only $43.50 in the public plants and $80 ($70, if the value of underground construction be deducted), or 84 per cent greater, in the companies. Also it appears, from the study made in the preceding chapter, that the line investment has been more economical in the latter, since for corresponding equipment they have expended from 15 to 20 per cent less than have the municipal plants.[1]

Though it would be rather difficult to estimate what portion of the station investment should be charged against the street lighting business, yet, in the light of the various analyses which have been made, it is probably safe to assume that the total investment lawfully created for the commercial service, is relatively 50 per cent higher in the

[1] The investment in distribution system — lines, poles, meters, transformers, and street lamps and fixtures — was, in 1915, $2,717,202 for the companies, and $1,272,470 for the public plants. The ratio of commercial lines to total lines was, in the former, about 69 per cent, and in the latter 62 per cent. Making the division accordingly, we find that the commercial line investment of the companies is roughly $1,874,868, while that of the municipal plants is only $788,931. These figures are, of course, only approximately correct.

The number of customers of the companies was 23,417, while that of the municipal plants was 18,069.

companies than in the municipal plants. This means that the former might be expected to make their rates sufficiently high to provide for fixed charges proportionately 50 per cent greater than those incurred by the other group, granting that they could secure their capital at the same figure — as a matter of fact they pay at least 1 per cent more. Now, without making any allowance for dividends on the investment, which we will assume are provided for out of the profits resulting from the larger business done, we find that the aggregate outlays of the companies for taxes, depreciation, and interest, amount to about 25 per cent of the total operating expenses (including taxes) plus the interest and depreciation charges.

Accordingly, since the investment per customer is 50 per cent higher, and since relatively 50 per cent more must be paid for the fixed charges, might we not, therefore, expect to find rates about 12 or 13 per cent higher in the companies than in the municipalities, since the unit cost of operation is about the same? In other words, would they not be justified in charging such prices as would make their total average income from sales of current, excluding street lighting and sales to other companies, at least 0.750 cents per kilowatt hour higher than the corresponding income of the public plants, which would be equal to 6.550, or 10 per cent above their present average income of 5.950 from this service? Or, if the company rates as they now stand are equitable, should not the municipal plants be furnishing current at about 88 per cent of their present rates, or 5.100, which is more than 14 per cent lower than the company rate?

Many objections can be raised against this line of argument, and it may not be a wholly accurate way of stating the problem; yet the writer believes that, to say the least, he has been sufficiently conservative in these calculations.

But, returning to a study of the rates as they actually

are, we notice that the commercial lighting rate of the companies has been reduced twice as rapidly as that of the public plants, until now it is a little less (10.062) than that of the latter (10.305),[1] in spite of the fact that they have been much more liberal in their policy of extending service to unprofitable customers, and have pushed their lines much farther in order to get new business.[2] The street lighting rates have been reduced but slightly during the period and now stand about 25 per cent below the commercial rates. All of this business, however, is done on the contract basis, at a fixed charge per lamp per year, with frequently more favorable rates for long-time contracts. The price charged for current sold to other companies, as might be expected under the circumstances, is about 75 per cent higher in the public plants.

The power rates have decreased much more rapidly in the municipal plants than in the companies, due to the great increase in this part of their business. It is rather surprising, however, to find the rate for power about one sixth lower (0.464) in the former (2.583) than in the latter (3.047). The difference is mostly accounted for by the municipal plant of Danvers, which sells a large quantity of power current at a rate of 1.634 per kilowatt hour, lower even than the Holyoke rate. Evidently, if we may judge

[1] For the municipal plants the sales to public buildings have been included with the commercial lighting though the rate charged for this service is only 8.018. This is necessary in order to keep our data comparable, even though, as sometimes it seems to happen, no actual transfer of cash is made by the municipality to its lighting department for this service.

[2] It is of some interest to note, in this connection, that the companies seem to make the same maximum net rate to all of their customers, even though they may be in other municipalities than those in which the plants are situated. On the other hand, the three public plants which have extended their lines outside their own borders, charge the customers in this foreign territory, respectively, 16.7, 27.2, and 53.0 per cent more than the usual rate. From this fact we can infer what might happen to their average rates if they served so many different places as do the companies.

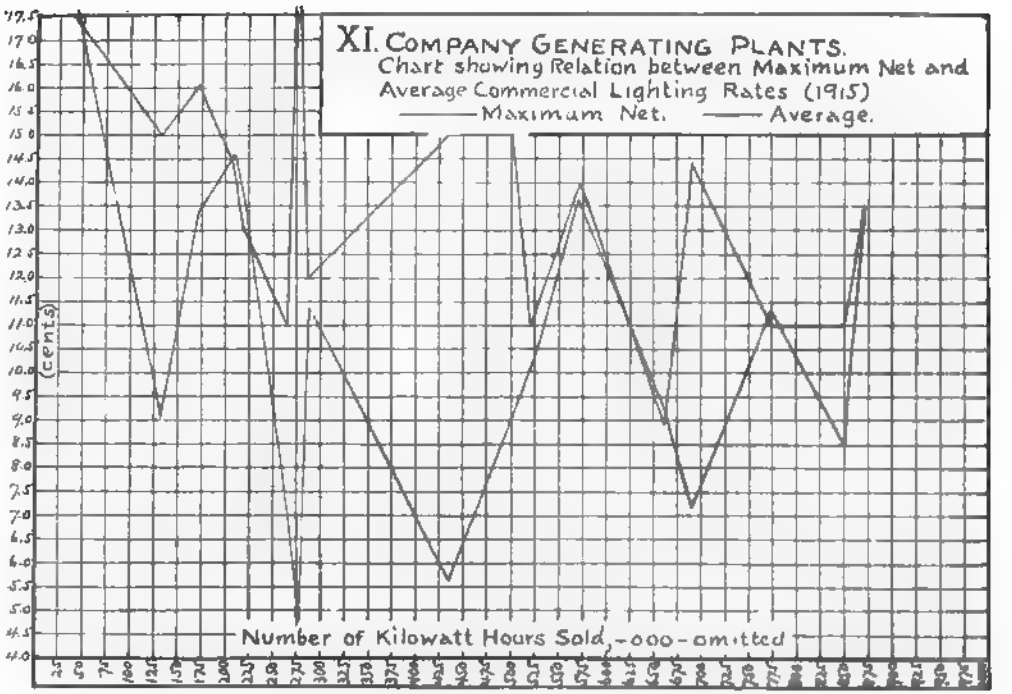
Table 29. Maximum Net Rates per K.W.H. (Generating Plants)

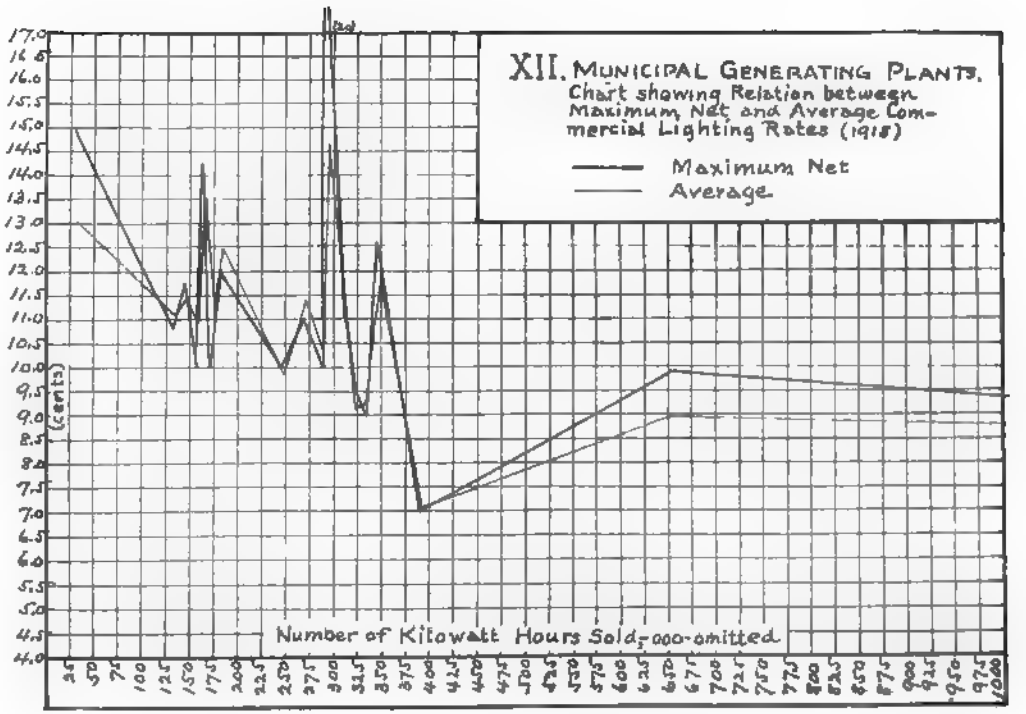
Municipality	Light		Power	
	1910	1915	1910	1915
Braintree	12.0[1]	10.0	6.0	8.0
Chicopee	11.85[1]	9.6	11.85	6.0
Concord	10.0	9.0	10.0	5.0
Danvers	10.0	10.0	10.0	10.0
Hudson	15.0	10.0	3.40	3.42
Hull	15.0	15.0	?	6.0
Ipswich	10 8	10.8	...	10.8
Mansfield	15.0	11.7	10.0	6.3
Marblehead	12.0	11.0	6.0	6.0
Merrimac	15.0	15.0	8.0	7.65
North Attleboro	15.0	12.0	9.5	8.5
Peabody	10.0	10.8	10.0	9.0
Reading	12.75	9.9	10.0	8.0
Taunton	13.0	9.9	10.0[1]	5.4
Holyoke	6.0	6.0	4.0	4.0
Middleborough	15 0	14.25	9.5	10.0
Wakefield	15 0	10.0	7.0	7.3
Westfield	10 0	7.0	4.5	4.0

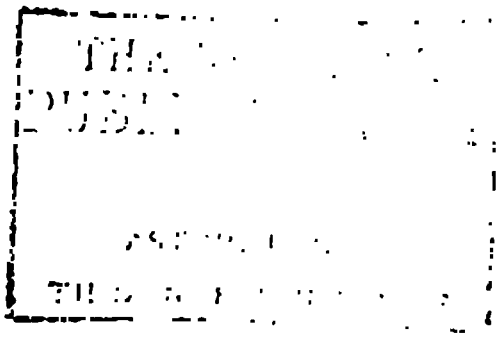
Company	Light		Power	
	1910	1915	1910	1915
Amesbury	16.2	16.0 (to 10.0)	10.0	10.0
Attleborough	15.0 (to 10.)	11.0	7.0	7.0
Buzzard's Bay	?	15.0	...	5.0
Gloucester	16 2	14 0	12 15	10.0
Great Barrington	14.4	14 4	10.0	8.0
Lee	20.0	20.0 (to 9.0)	20.0	9.0
Leominster	16.0	12.0	10 0[2]	5.0
Northampton	15.0	9.0	10.0[2]	6.7
Plymouth	16.2	14.4 (to 9.0)	10.0	10.0
Quincy	17.0	13.5 (to 10.)	10.0	9.0
Weymouth	15 0[1]	15.0	15.0	13 5
Winchendon	20.0	12.0	10.0	10.0
Beverly	12.0	11.0	10.0	9.0
Citizens' (Nantucket)	20 0	20.0	...	...
Newburyport	15.0	13.0	9.0	9.0
North Adams	13.5	11 0 (to 8.0)	4.0	4.0
Vineyard	27.0	17.5	10.0	7.0[2]

[1] Meter rent charged.

[2] Service limited from midnight to 6 P.M.


XI. COMPANY GENERATING PLANTS.
Chart showing Relation between Maximum Net and Average Commercial Lighting Rates (1915)
——— Maximum Net. ——— Average.
(cents)
Number of Kilowatt Hours Sold, -000- omitted


XII. Municipal Generating Plants.
Chart showing Relation between Maximum Net and Average Commercial Lighting Rates (1918)
Maximum Net
Average
(cents)
Number of Kilowatt Hours Sold,-000-omitted



by the average capacity of its connected motors (13.23 K.W., or more than 100 per cent larger than the average for the group, and much larger than the motors of any other plant in either group) this plant has an unusually favorable business. It must also be recalled that the average size of connected motors (6.47 K.W.) is somewhat greater in the public plants than in the companies (5.95 K.W.). Finally, in both cases it will be observed that the average charge for current supplied for power purposes is much below the *average* cost of production of all classes of current, as revealed by the operating expenses.

As to the equitableness of the various rate schedules, not much need be said, as we are not particularly concerned with individual cases. Most of the lighting current is sold at a fixed rate per kilowatt hour, subject to prompt payment discounts. However, one of the public plants and 6 of the private plants give quantity discounts for his service. Also 6 of the former and 10 of the latter appear to offer contract rates, which are too varied to admit of any classification. Nor are these schedules, in most cases, important, for very little contract lighting business is now done. Several plants make special rates to large consumers, to summer customers, or to those who use current for arc lights. Finally, every municipal plant except one imposes a minimum monthly or yearly charge upon lighting customers, varying from $0.50 to $1 per month, and all but two of the other group report a similar charge, which is usually $1 per month; in rare instances this charge takes the form of a meter rental.[1]

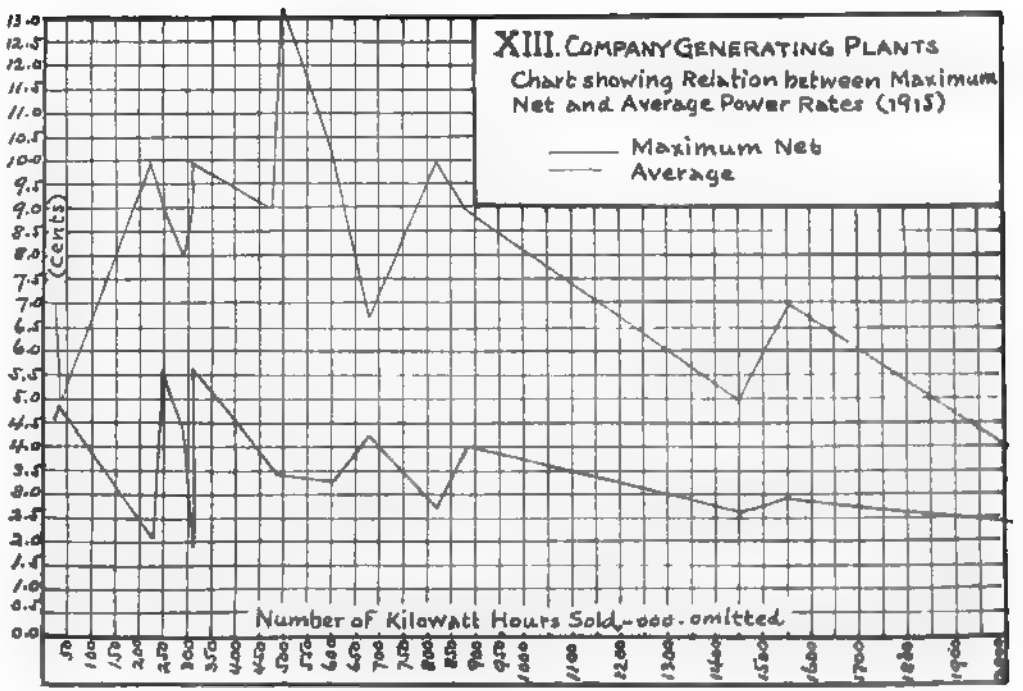
In the accompanying charts are shown the differences between the *average* and *maximum net* rates, which result from the rate schedule of the two groups of plants. The

[1] Cf. Mass., 1913, ch. 623. "No charge shall be made by any person, partnership or corporation furnishing electricity for lighting purposes for the use of a meter during any portion of twelve consecutive months, if the consumer during that period uses electricity to the value of nine dollars."

state of affairs disclosed is highly interesting, though not to be wondered at. The close correspondence between the two in the case of the municipal plants — even in Holyoke, which has a maximum net rate of 6 cents and an average of 5.980 — indicates that practically all customers are served alike, and that the municipalities are not making any particular attempt to develop their lighting business by the offer of specially attractive rates. There seems to be no tendency whatever for lower rates to be charged by those plants which have a higher average consumption of current per customer. That the average rate is sometimes a little higher than the maximum net, is in the main accounted for by the minimum charges and the prompt payment discounts lost.

The companies, on the contrary, have *maximum net* rates which seem to be for the most part merely nominal, particularly in several of the smaller plants. Obviously, in some cases, certain classes of customers gain enormously by the special rates or quantity discounts, though these usually become effective so speedily that all customers are benefited thereby. The very slight difference between the maximum and average rates in a number of the larger companies, *may* mean that they are not desirous of increasing the lighting portion of their business at the present time. We also know that they have a large number of small customers, and that their power business is relatively small. Our data show that, in the case of Gloucester and Quincy, which have unusually high rates in view of their large total sales, the consumption of current per customer is much below the average for the group. On the other hand, the plants showing the widest spread between the two rates, such as Lee and Vineyard, sell a relatively large amount of current per lighting customer.

In connection with these rate schedules, it must be observed that none of the plants of either group do any free wiring. Also, 9 of the companies and 10 of the municipal


XIII. Company Generating Plants
Chart showing Relation between Maximum Net and Average Power Rates (1915)
Maximum Net
Average
(Cents)
Number of Kilowatt Hours Sold, -000. omitted

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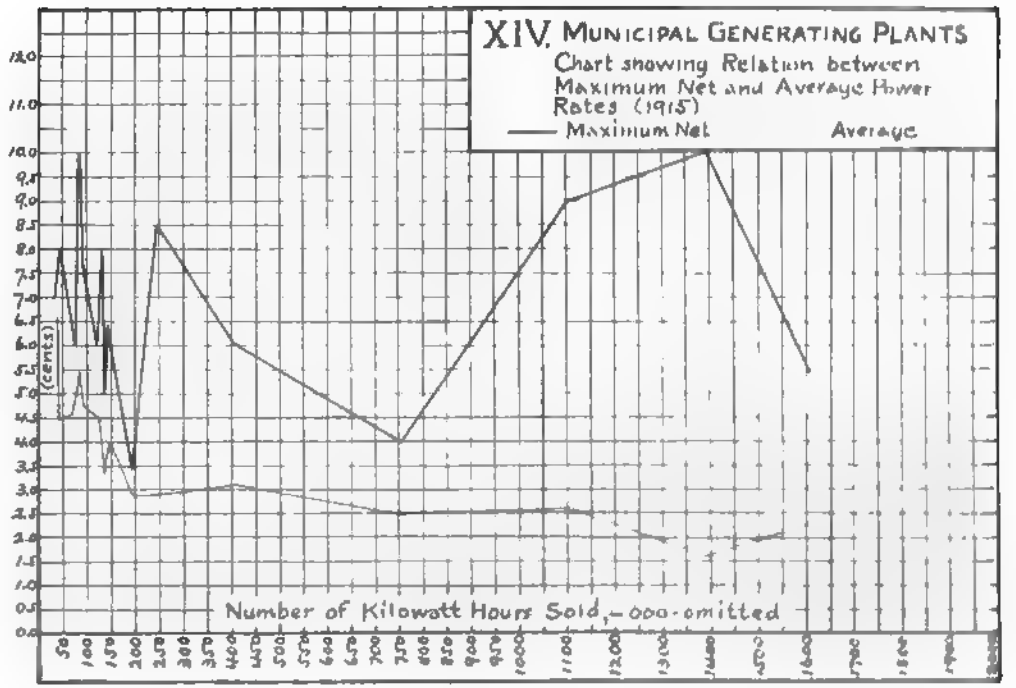
XIV. Municipal Generating Plants
Chart showing Relation between Maximum Net and Average Power Rates (1915)
Maximum Net
Average
(cents)
Number of Kilowatt Hours Sold, - 000 - omitted

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plants make no free renewals of lamps. But 6 of the former and 7 of the latter renew carbons, while one of the former and two of the latter renew tungstens under certain conditions.

In the matter of power rates the usual custom in each group is to fix a certain minimum monthly charge per horse power of connected load, usually $1, followed by a charge per kilowatt hour decreasing with the quantity of current consumed, according to the Wright method. A study of the maximum and average rates of the plants in each group, as revealed in the charts, indicates that they have adopted similar methods of rate making, and that even in the smaller plants, the schedules are such as will benefit the average customer.

The average price received per kilowatt hour for street lighting shows a marked tendency to decrease as the quantity supplied increases, particularly for amounts above 100,000 hours.

By reason of the diverse conditions under which the plants operate, it is probably futile to attempt any comparison of the individual unit income of each group. However, having excluded the street lighting business in order to make the companies roughly comparable with the municipal plants, we find that, for total sales under 800,000 kilowatt hours, the former have a markedly smaller income per kilowatt hour than the latter. Yet, above this point, the average rate is considerably higher in several of the companies than in the corresponding public plants. The three plants which practically account for this difference are Beverly, Gloucester, and Quincy, each of which has either a very high investment per customer, high operating expenses, due to the character of the business done, or both. For the most part, also, they do a lighting rather than a power business, and in the quantity of current delivered per customer they stand at the bottom of the entire group of companies. Were it not for these exceptional cases, the

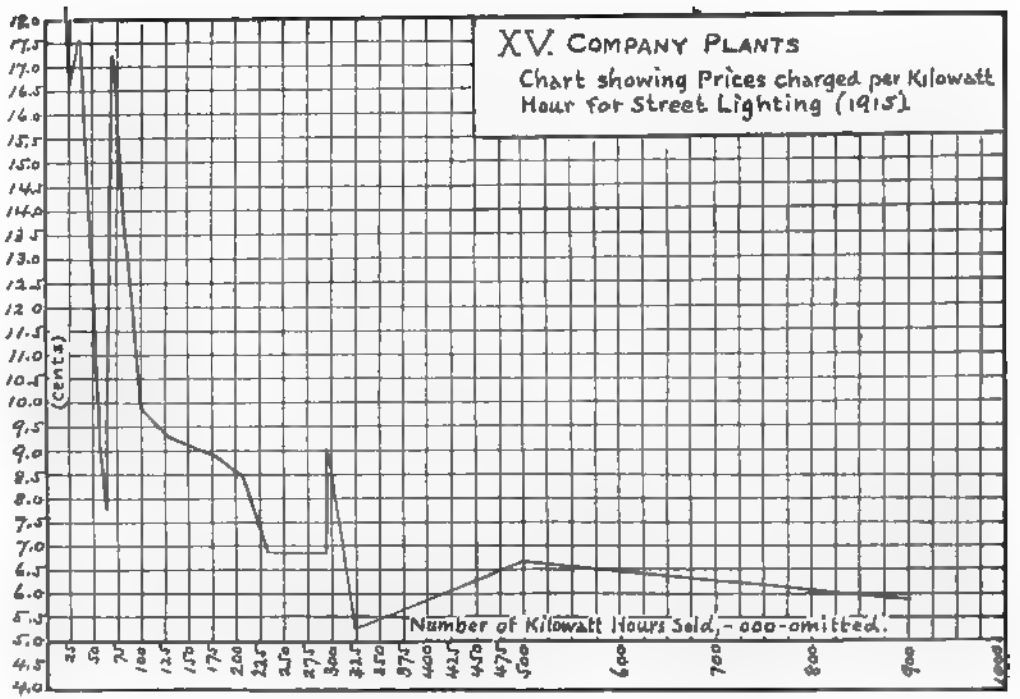
curve of the private plants would almost always run below that of the other group, and in only a few instances slightly above it.

Table 29 (p. 202) shows that the rate of increase in operating income has been about equal in the two groups since 1910, whether or not the street lighting income be included in the case of the companies. The growth in net income has also been approximately the same, if street lighting be included. The gross income of the companies exceeds that of the other group by 110.9 per cent, and their actual *sale* of current — as distinguished from current "delivered" in the public plants — was 114.6 per cent greater. But their gross income, excluding street lighting, as we must do for comparative purposes, was only 71.6 per cent larger than that of the municipal plants, while the quantity of current sold for commercial purposes was 84 per cent greater. Finally, the total operating expenses of the private plants were only 55.1 per cent above those of the other group.

Again, the net income of the private plants, including street lighting, is about five times as great as that of the municipal plants, or, excluding the street lighting income, two and one half times as great. The comparative net income per kilowatt hour sold for all commercial purposes is 0.957 in the latter, and 1.332, or 35.2 per cent more, in the former.[1]

At first it may appear that the absolute financial advantage, which, from these analyses, the companies appear to have, is due solely to the greater amount of current which they sell. However, an examination of the relation

[1] Two of the municipal plants, Hull and Wakefield, were subject to an actual loss in operation of about $3,500. None of the companies was operated at a deficit; but if the street lighting income be deducted in each case, so that we can have a basis for comparison with the municipal plants, it appears that three plants, Buzzard's Bay, Citizens', and Vineyard, would have suffered a deficit amounting in the aggregate to about $7,000.


XV. Company Plants
Chart showing Prices charged per Kilowatt Hour for Street Lighting (1915)
(cents)
Number of Kilowatt Hours Sold, - 000 - omitted.

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which the operating expenses bear to the operating income, discloses the fact that there is greater operating efficiency in the former, and that their improvement has been more rapid. At the present time the *operating ratio* of the companies, omitting the street lighting income for the sake of comparison, is 75, while that of the public plants is 83.7, or relatively 11.6 per cent higher. This ratio has been reduced during the five-year period 9.5 per cent by the former, and only 2.3 per cent by the latter, though the companies at the earlier date had only a slight advantage in this regard. Nor do these computations make any allowance for the fact that taxes and other charges not incurred by the municipal plants are paid by the private plants. To this aspect of the matter, reference will shortly be made.

TABLE 30. PERCENTAGE ANALYSIS OF THE VARIOUS CLASSES OF INCOME

Class of income	*1910*		*1915*		
	Municipalities	*Companies*	*Municipalities*	*Companies*	*Companies (street lighting out)*
Commercial lighting...	78.1	54.3	72.0	53.1	65.3
Power.....	18.5	20.3	25.3	22.4	27.5
Street lighting.....	...	20.6	...	18.7	...
Other companies.....	0.6	4.1	0.9	5.2	6.4
Other sources.....	2.8	0.8	1.8	0.6	0.8

So far as the percentage distribution of the income between the various classes of business is concerned, when the street-lighting income of the companies is deducted, we find that there is little to choose between the two groups, except in the matter of sales to other companies.[1] It will

[1] Though the public plants of Holyoke and Mansfield sell to the local authorities the current used for street lighting, and make a corresponding entry in the income account, just as if they were private concerns, this "income" is naturally not included, since the averages would thereby be distorted.

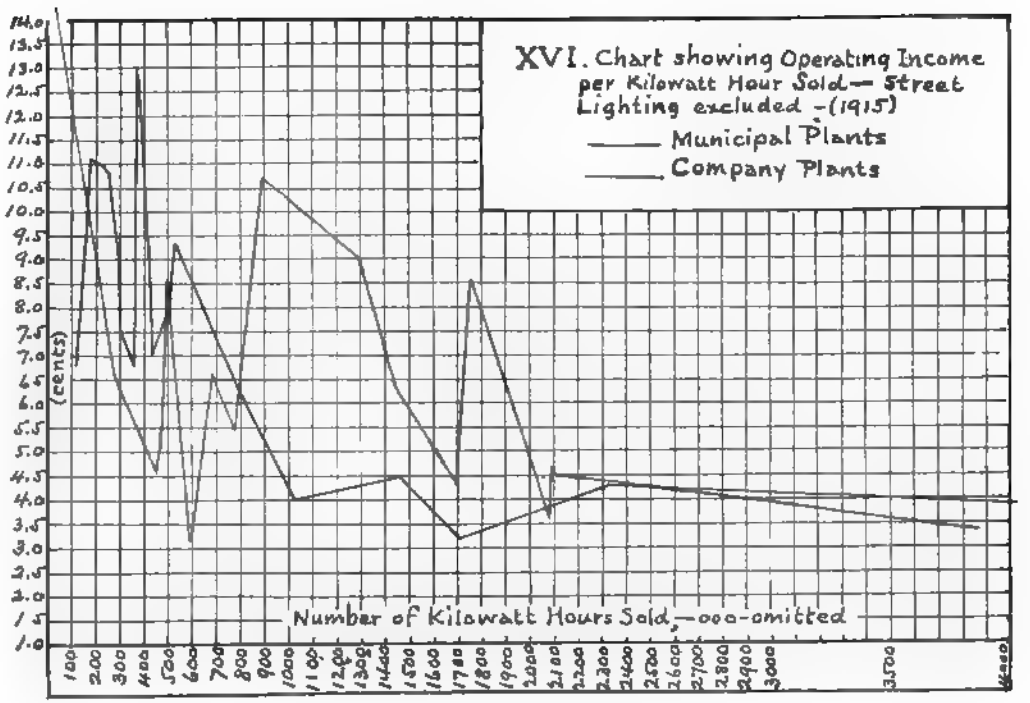
also be observed that the income from "other sources" is proportionately higher in the municipal plants.

Before leaving the subject of the income, it is instructive to make a few more analyses. In the first place, while the investment per dollar of operating income, excluding street lighting, has decreased from $5.27 to $4.35, or 17.5 per cent for the municipal plants, it has increased from $4.20 to $4.80, or 9.5 per cent for the companies. In other words, the comparable income per dollar of investment is in the former 23 cents and in the latter 21.7 per cent. The difference, to be sure, is slight; but the tendency indicated during the past five years is sufficiently obvious. In the light of our previous analyses, this increasing investment is justified; though, as has already been suggested, it does not appear that the companies are taking advantage of this fact so far as their rate policy is concerned, notwithstanding their fixed charges are proportionately increased.

While the total income per customer from light and power sales has decreased more rapidly (25.7 per cent) in the companies than in the public plants (19.8 per cent), — the absolute figures are still about 25 per cent higher in the former ($45.75) than in the latter ($36.19), — both in light and power income they are in the lead. The *per capita* income also, when the street lighting income of the companies is deducted, is 25 per cent greater in the one group ($4.03) than in the other ($3.26). A like rate of increase in this item is to be found in both cases (32 per cent). Finally, the increase in the street lighting income per capita is due to a longer hours' use of lamps per night, rather than to an increase in the connected load.[1]

The average income per kilowatt connected load, excluding street lighting and sales to other companies, is, for the 9 municipal plants furnishing the complete data, $26.41, and for the companies $28.20, and the rate of decrease since 1910 has been more rapid for the latter. These figures

[1] Appendix, pp. 410–413, 416–417.


XVI. Chart showing Operating Income per Kilowatt Hour Sold — Street Lighting excluded -(1915)
Municipal Plants
Company Plants
(cents)
Number of Kilowatt Hours Sold,—000-omitted

are surprisingly close together. Taken separately, we find the income per connected commercial lighting load to be almost identical in the two groups; but the public plants have had an actual increase in this item (1.8 per cent) during the period, while the companies have been subject to a decrease of 18.6 per cent. This fact serves to prove our earlier conclusions to the effect that the latter are rapidly extending their service to the less profitable customers, while the former are avoiding the unattractive business. In this connection it must also be remembered that the consumption of current per kilowatt connected lighting load has increased 10 per cent for the public plants and has decreased 5.6 per cent for the private plants.

It is instructive to note that the rate of decrease in income per connected power load has been twice as great in the municipal plants (38.7 per cent) as in the other group (18.6 per cent). This is accounted for largely by the great reduction in the power rates of the municipal plants.

The income per kilowatt capacity of dynamos (street lighting excluded) has remained practically unchanged throughout the period, but is absolutely about 25 per cent higher for the companies. This condition is due in large measure to their better load factor and better diversity factor, as well as to the fact that their dynamo capacity, in proportion to the amount of business done, is somewhat less.[1]

Summary

From this chapter the following facts stand out prominently.

1. If municipal plants abide by the law, which forbids

[1] Attention should be called to the fact that, while the income of the companies, excluding the street lighting income, is 25 per cent higher than that of the municipal plants, whether per customer, *per capita*, or per kilowatt capacity, the income per kilowatt connected load is only 7 per cent greater. This, again, indicates that they have made provision for a large proportion of customers with bad load factors, thereby, perhaps, improving their diversity factor.

them to sell current below cost, — cost being broadly defined as including not only operating expenses but also charges for interest, depreciation, and maturing debt, — they cannot possibly lose money in operation. In 1915 only two of these plants, Hull and Wakefield, showed an operating deficit.

2. In 1910 the average unit cost of the companies was conspicuously lower than that of the other group.

3. Between 1910 and 1915 the public plants reduced their unit costs much more rapidly than did the private plants.

4. At the present time, when the total unit costs of the companies are put on a comparable basis, they still have a considerable advantage over the municipal plants, a part of which is probably due to their greater output.

5. The companies have a very noticeable advantage over the other group so far as the unit cost for "manufacturing" is concerned.

6. The average income from all sales of current per kilowatt hour is almost identical in the two groups, with a slight advantage for the companies, except in the matter of power sales, in which the unit income is somewhat lower for the public plants, due to one or two exceptional cases.

7. The much more marked rate of decrease in the unit income of the municipal plants has been occasioned by the rapid growth of their power business.

8. Because of the far greater investment per customer in the companies, we might logically have expected considerably higher rates than we do find, or, on the other hand, we might have looked for proportionately lower rates in the public plants.

9. While the *maximum net lighting* rates appearing in the companies' schedules average higher than those of the municipal plants, these rates are rarely effective, because of the liberal application of the quantity discount policy. Hence even the small consumers rarely pay more than

would be charged by the municipal plants, in which the *maximum net* rate is almost without exception also the *minimum* rate.

10. Though the *maximum net power* rates of the companies are in the main higher, in this case also the quantity discounts take effect early, so that, again, the position of the smaller customers is about the same as in the public plants.

11. The *operating ratio* of the companies is considerably better than that of the public plants, the latter having shown little improvement in this regard since 1910.

12. Holyoke, as might be expected, shows a much lower unit cost (1.592) than that found in any of the other plants. This advantage in operation, however, is largely the result of abnormally low distribution expenses (0.266) due to the small length of lines, rather than to economies in generation, in spite of the use of some water power. The unit income (2.831) is not much lower than one would reasonably expect, in view of the nature of this plant's territory and business.

CHAPTER VII

FINANCIAL STATISTICS OF GENERATING PLANTS
(concluded)

1. Disposal of Net Income [1]

We are at length in a position to make some examination of the financial results of operation in the two groups of plants, as shown by the disposal of their net income. Adding to the net a few practically negligible profit and loss items of income, derived for the most part from "jobbing," interest on deposits, and the rent of fixtures, we find the total to be $566,521 for the companies and $112,075 for the municipal plants, against which charges are made as indicated in Table 31.

It is interesting to observe that, while the companies have financed themselves to the extent of a little more than three fifths of their investment by means of stock issues, yet their total interest payment on notes and bonds is almost 50 per cent greater than that of the public plants. The actual amount of interest paid per kilowatt hour delivered is almost the same in the two groups, 0.414 cents in the latter and 0.369 in the former, in spite of the fact that the municipal plants must secure their capital wholly by borrowing, unless they call on the tax levy.[2] It is to be remembered, however, that the private plants

[1] Appendix, pp. 454–457.

[2] In 1915, this group of municipal plants (Holyoke excluded), had outstanding $1,283,010 in bonds and $278,210 in notes, a total of $1,561,220, or 53.4 per cent of the total investment ($2,923,825). The remainder of the expenditures on capital account have been secured from the tax levy, either through "appropriations for construction," "appropriations for bond and note payments," or "appropriations to the sinkng fund." The sum total of payments to these accounts out of earnings is exceedingly small.

TABLE 31. PERCENTAGE ANALYSIS OF CHARGES AGAINST INCOME

Item	Companies		Municipalities [1]		Holyoke
	Amount	Per cent of total	Amount	Per cent of total	Per cent of total
Operating income	$1,417,235	...	$671,761	...	...
Other income (profit and loss items)	22,222	...	2,957	...	...
Total	$1,439,457	...	$674,718	...	...
Total available ("net")	566,521	...	112,075	...	...
Charges against income:					
Operating expenses	872,935	62.5	562,643	70.0	67.3
Interest	90,094	6.4	62,143	7.7	7.6
Depreciation	56,314	4.1	92,306	11.4	15.7
Dividends	353,870	25.4	...	...	...
Sinking fund payments	...	...	24,596	3.0	...
Note and Bond payments	...	...	55,797	6.9	9.2
All other charges	23,415	1.6	8,096	1.0	0.2
Total	$1,396,628	100.	$805,581	100.	100.
Balance	42,829	...	*130,863* (deficit)	...	...

[1] Holyoke omitted.

pay from 1 to 1.5 per cent more for their borrowed capital than do the public plants, which have the entire assets of their municipalities to offer as security. The one group pays an average rate of not more than 4 per cent, while the other pays from 5 to 5.5 per cent, and sometimes higher.[1]

The unit charges for depreciation, as a result of the statutory provisions, are much higher (0.615 cents), in the municipal plants than in the companies (0.234 cents), in

[1] This was true for conditions as they were prior to 1915. During the present abnormal times the rates for new loans run much higher in both groups.

which they constitute only 4.2 per cent of all charges against net income. More detailed attention will in a moment be given to this particular item.

As would be expected, the larger share of the net income of the companies goes to the stockholders. The total amount of dividend payments during the year was $353,870, or 25.4 per cent of all charges against income. Three of the smaller companies, to be sure, paid no dividends,[1] but the remaining 14 paid at rates ranging from 5 to 32 per cent. The average rate was 11.94 on the outstanding stock of all the companies (10.8 if premiums be included), or 6.66 on the entire investment. Apparently there could, in some instances, be an appreciable lowering of the rates without doing any injustice to the stockholders, though it must not be forgotten that frequently present high returns merely compensate for earlier low returns or the failure to earn any dividends whatever.

The miscellaneous charges against income appearing in the profit and loss accounts, are too small to deserve attention. The sinking fund and maturing debt payments of the public plants, however, — which, by the way, do not theoretically belong here, — are a considerable item, amounting in the former case to 0.164 cents per kilowatt hour delivered, and in the latter to 0.372. Together they amount to $80,393, or 9.9 per cent of all charges against income, if we consider that they should be counted in this connection. After all payments have been deducted, the companies show an operating balance for the year of $43,929, while the municipal plants are subject to a deficit of $50,415, or $130,809 if the charges just mentioned are included.

Now, before discussing these charges which are in themselves of no great significance for our comparative study, let us make a more careful study of the amount charged off for depreciation by each group of plants, for this is one

[1] Buzzard's Bay, Citizens', and Vineyard.

of the vital issues which confront us in an investigation of this kind.

Accordingly, we must note first that during the year 1914–15, 7 of the 17 companies made no allowance whatever for depreciation. During the five-year period there are 3 plants which have never credited anything to this account,[1] and there are only 6 which have regularly written off their depreciation each year.[2] Of the individual plants, 2 charged off more than in the preceding year, and 6 made a less allowance. Also, 2 which in the preceding year charged off depreciation failed to do so in 1914–15, while 2 others which had not done so at the earlier date made a slight allowance this year. From these data it should be sufficiently apparent that the rate of depreciation provided for by the separate companies which actually write off depreciation, is considerably higher than the average for the group. This rate we find for 1914–15 to be 1.64 per cent of the total investment of the plants reporting this item, or 50 per cent higher than the average rate for the entire group.[3]

Bearing these considerations in mind, we must attempt to discover the significance of the fact that the depreciation charges of the public plants are 150 per cent higher per kilowatt hour delivered than those of the private plants, or, computed as a portion of the total investment, why the ratio thus expended by the former (3.16 per cent) was 200 per cent greater than that of the latter (1.10 per cent). This marked lack of correspondence might be accounted for in several ways:

[1] Buzzard's Bay, Newburyport, and Vineyard.

[2] The number of plants making allowance for depreciation during the series of years, 1910–15 inclusive, was, respectively, 11, 9, 13, 11, 10, 10. The average number thus appears to be 10.7 per year, or about two thirds of the total number.

[3] The plants not writing of depreciation during this year were Buzzard's Bay, Newburyport, Plymouth, Vineyard, Weymouth, and Winchendon. The total investment of this group was $1,730,094, or about one third of the total investment of all of the companies studied.

1. The legal amount written off annually by the municipal plants may be somewhat higher than is necessary in order to meet the depreciation as it occurs. Some support for this view is found in the fact that they now have depreciation funds carried as assets, amounting in the aggregate to $96,728, or 3.3 per cent of the total investment of the 17 plants, and that the net addition to these funds during the year 1914–15 amounted to $16,641, between one fifth and one sixth of the total depreciation allowance, equivalent to 0.111 cents per kilowatt hour delivered, or 0.57 per cent of the entire investment. But this explanation does not throw much light on the problem when we find that in two or three instances the companies also have created little depreciation or reserve funds, which, however, they customarily carry as a liability, and for which they make no separate return, so that in all probability the sums so designated have simply been spread over various portions of the assets.[1]

2. From another angle it may be argued that the public plants have used a portion of their depreciation for additions to plant instead of for renewals, while the companies, on the other hand, have charged off only enough to meet the necessary renewals. And, as a matter of fact, the municipal plant returns indicate that about $20,000 has been put into new construction during the year, though the records are kept in such a way that it is frequently very difficult to differentiate additions and extensions from renewals. But if we assume that our figures are correct, together with the amount added to depreciation funds, we could thus account for at least two fifths of the total depreciation written off by the municipal plants as used for purposes other than current renewals.

From a careful study of the returns it does not definitely appear that more than $40,000 of the total depreci-

[1] In two or three instances small earning investments have been created at one time and another. These, however, scarcely merit attention.

ation was used for renewals. This would be equal to 0.267 cents per kilowatt hour delivered, and 1.4 per cent of the total investment, or in reality only slightly higher relatively than the amount written off by the companies.[1] It is rather difficult to say exactly where the remaining $10,000 to $15,000 of their depreciation went. Some of it was used for extensions, some for renewals, no doubt, and some was even transferred to the operating accounts for current repairs and there debited. Also, it is very certain that, in view of the comparatively small amount charged off, the entire depreciation allowance made by the companies was not more than sufficient to cover renewals and extraordinary repairs — indeed, it would scarcely seem to be enough for this purpose.

Here, then, we have pretty good evidence that the actual provisions for present depreciation may not have been particularly different in the two groups after all. And we know conclusively that the companies are disposed to provide for their depreciation either when it is most necessary or when it suits their convenience, rather than according to any fixed policy.

3. Again, there is the possibility that the companies are more skillfully managed than the public plants, and that their equipment is newer and their construction and engineering better, so that the element of depreciation has been reduced to a minimum. Hence their charges under this head would be correspondingly low. There is no doubt a good deal of truth in this argument, when we remember that their station units are considerably newer (7.6 years as opposed to 9.1 years), that they use comparatively few foreign poles, and so would have less trouble with their lines, and that nearly half of their distribution system has been installed since 1910. Local conditions may also affect the problem, as well as the fact that there is a certain

[1] The rate is a little less than that of the companies actually reporting depreciation allowances (1.64 per cent).

amount of underground construction in the companies. It is also probable that in the case of many of the plants the personal factor is important; but we are not now in a position to state definitely just what weight should be attached to this element.

4. Furthermore, it may be suggested that the companies are providing for their depreciation in the operating accounts; that they have adopted the "one hundred per cent efficiency" slogan of the "boys" who are in the electric light and power business, as represented by the National Electric Light Association. While they do not call depreciation by that name, they may provide for it all the same in their current repairs.

But if this were the case, we would expect, other things being equal, to find a comparatively high unit cost for repairs of central plant and lines. In this, however, we are somewhat disappointed, for it appears that the total expended for repairs and renewals appearing in the operating accounts, was relatively lower per kilowatt hour delivered for the companies (0.380 cents) than for the municipal plants (0.519 cents). In relation to the total investment in both groups, the amounts thus expended were respectively 1.83 and 2.78 per cent.[1] Of course, some of the preceding considerations regarding more careful management and more modern equipment, apply here as well; yet this argument is not sufficiently conclusive.

5. Finally, there is the possibility, in fact a strong

[1] In making this computation the writer has attempted to separate out the expenditures strictly for repairs from the other items in the distribution expenses. Consequently, only the entry "repair of lines, arc lamps, and meters" was taken for the public plants, and the items, "repairs and renewals of lines and conduits" and "repairs and renewals of meters and transformers," for the companies. The amount accredited to the former under this head will be relatively too high, because it includes arc lamp repairs. If *all* of the items under distribution expenses which relate in any way to repairs be included, the ratios are increased to 2.4 per cent and 3.4 per cent, respectively, while the difference between the two remains practically unchanged.

probability, even granting that there may be some truth in all of these arguments, that the year 1914–15 was not a typical year so far as the industry was concerned. Chance may have played some part; but we know further that the market conditions were abnormal and that the price of material became almost prohibitively high. Under these circumstances, might we not logically expect that the companies, which are bound by no legal restrictions in the matter, would put off until better days a good many of the customary renewals, and consequently write off a correspondingly smaller amount of depreciation? Might they not also be induced by the desire to pay the customary dividends, to postpone repairs wherever possible, whereas the public plants would be subject to no such influence?

The writer has satisfied himself on this point by making a careful study of all of the returns of each plant for the years 1910 to 1915 inclusive. The results of the computations made appear in the accompanying table (Table 32) which presents some unusually significant data.

In the first place, it is evident that the companies, as is frequently asserted, have provided for their depreciation as it has occurred, and that the average yearly rate has been even a little higher than that of the municipal plants, though there have been wide fluctuations from year to year. If the investment in real estate were deducted in both groups, since so large a number of the public plants either do not value their land at all or value it low, the difference in favor of the companies would be even more marked.

In the expenditure for repairs, the public plants have maintained a remarkable uniformity, as have also the companies, if the last year be omitted. In the case of the latter, the rate of depreciation charged off each year does not seem to have had any noticeable effect upon the ratio expended for repairs, except that in the year when the

TABLE 32. RELATION BETWEEN INVESTMENT, DEPRECIATION, AND REPAIRS, 1910–1915

Year	Investment in plant		Depreciation			Operating Repairs				Number of companies writing off depreciation
	Municipal[1]	Company[2]	Municipal	Company		Municipal		Company		
				Total	Per cent of investment	Total	Per cent of investment	Total	Per cent of investment	
1910	$2,336,837	$3,124,823	3 per	$180,674	5.8	$69,917	3.0	$99,468	3.2	11
1911	2,388,640	3,437,147	cent	98,253	2.9	70,646	3.0—	80,274	2.4	9
1912	2,598,561	3,826,084	of In-	157,057	4.0	80,299	3.1	91,512	2.4	13
1913	2,657,421	4,183,618	vest-	142,894	3.4	80,834	3.0	101,990	2.4	11
1914	2,812,187	4,808,118	ment	93,978	2.0—	99,314	3.8	97,310	2.0	10
1915	2,923,825	5,284,275	($92,306)	56,314	1.1—	81,003[3]	2.8	96,901	1.8	10
			(3.1)							
Average (arithmetical)	...	...	3.0+	...	3.2	...	3.1	...	2.4	10.7

[1] Holyoke out.

[2] Plant account.

[3] Hull's extraordinary repairs omitted.

depreciation was highest, the amount expended for repairs was also highest, and in the two years, when the former was lowest the latter was, strange to say, also lowest. That these expenditures are proportionately somewhat less (25 per cent) in the companies, is largely accounted for by the fact that they have been making extensions and improvements of all kinds apparently much more rapidly than have the municipal plants — a condition clearly shown by the table of investments for each year. The reasons above given are also of considerable significance.[1]

Since the two years of most rapid growth in investment are the years of most noticeable decrease in the amount of depreciation charged off, there might seem to be some ground for the assertion that the companies have been charging to capital account the depreciation which should be met out of earnings. But under these circumstances we would hardly expect a concomitant decrease in the proportionate amount expended for repairs in the operating account. Furthermore, as it appears from our earlier analyses, they have more tangible, serviceable property as a result of their capital outlays than have the municipal plants. Also the reasons for the decreased expenditure for repairs have probably been sufficiently accounted for. Hence this particular objection does not seem to be valid.

Again, an examination of the table shows that in the years of least increase in investment, the amount of depreciation charged off was highest. This fact clearly indicates that the private plants have not been deferring their depreciation. It may, however, be asserted with some

[1] It must also be remembered that the repair figures for the companies in 1914–15 are disproportionately low when compared with the figures for the other group, because they do not include maintenance and renewals of arc lamps as is the case in the public plants. Also, in a number of cases the wages of linemen have been included with the general distribution wages instead of with the items for repairs and renewals, as in the municipal plants. For this reason, again, the figures will be somewhat too low.

assurance that in the years of most rapid expansion the line between renewals and actual additions or extensions has not been clearly drawn. And, indeed, few of the plants, either private or public, appear to make any careful distinction on this point, so far as one can gather from the returns submitted to the Board. In this connection it is significant to remember that the municipal plants themselves did not in the last year actually expend for renewals more than one half of the depreciation which was appropriated by the local authorities, or 1.5 per cent on the total investment.

The writer's conclusions are, that, while there may have been one or two doubtful cases, and while the marked drop in the rate of depreciation charged off by the companies in 1914–15 may have been in considerable measure the result of abnormal market conditions, yet the smaller rate usually written off during the years of heaviest investment is sufficiently accounted for by the fact that the great increase in new assets and legitimate improvements, has naturally made the proportionate amount of annual depreciation less. Past history indicates that, with a few exceptions, they are being properly financed in this regard. Though several of the least efficient plants, which are usually unable to pay dividends, have been negligent in the matter, the remainder make an unusually good showing for the group, as compared with the municipal plants, when we remember that on the average not more than two thirds (10.7) of the entire number have charged off depreciation each year. The *average* rate of depreciation for *those actually making the allowance is considerably higher* than that of the public plants. And, finally, the uniformly smaller proportionate expenditure by the companies for repairs, while it may depend slightly upon greater size of plant, and while it can in instances be accounted for on other grounds, is probably due to more efficient management and superior equipment.

This study, made independently after the writer had finished his investigation of the physical development of the two groups of plants, seems not only to confirm the earlier conclusions reached, but also these later conclusions derive their validity largely from the earlier analyses. Did we not have some tangible evidence regarding the physical conditions of our plants, we would have great difficulty in knowing whether a given policy of investment and depreciation is sound or the reverse. In order not to be led astray, the investigator of problems such as these must endeavor impartially to consider *all* of the factors involved, and even then allowance must be made for exceptional cases, for local conditions, and for other considerations which are too intangible to appear in any published records. In order to discover whether the private plants have been, in the ideal sense, wisely financed, it would be necessary to go through the books of many a voluntary association and to delve into the secret councils of many a group of investors.

But it is not our purpose to attempt here to develop a program of financial reform for the electric light and power business of the State, if, indeed, such be needed after thirty years of judicious regulation, free from any political bias. We merely wish to make an honest comparison of public with private enterprise. And, in the important particular which has just been considered, a point in which private business frequently goes wrong and in which public business, unrestricted, almost invariably fails, our group of companies, many of them far from ideal, some of them, it may be, controlled by individuals whose chief concern is to make profits out of them, and subject only indirectly to commission control of their depreciation policy, have, in the ultimate analysis, in spite of superficial appearances, given an equally good if not better account of themselves than have the corresponding group of municipal plants, which have been definitely restricted as to the policy which

they shall pursue. Regardless, however, of what may have been the annual allowances for repairs and depreciation, the local survey will presently disclose the fact that the municipal plants in general have not been so well kept up as have the private plants.

The reader might very properly ask if it is not possible that the policy followed by the Board of Gas and Electric Light Commissioners regarding the increase of capital, may have become more liberal during the past two years, thus leading to the noticeable increase in plant investment, which might be occasioned partially by the capitalization of depreciation in the issue of new stock, as well as by the supposed practice of covering up losses in operation by the floating of coupon notes which may ultimately be funded or capitalized. Such, however, is decidedly *not* the case.[1] In those very years in which the investment was increasing most rapidly, the laws, at the urgent request of the Commissioners, were being made more strict. Holding companies were abolished,[2] the authority of the Board over voluntary associations was more definitely extended,[3] and the control over stock and bond issued was so increased that the use to which new capital should be put is to be absolutely prescribed by the Board.[4] Notwithstanding these recent restrictions, however, there was no decrease in the rate of issue of new stock during the last two years, while for all of the companies in the State there has been an actual diminution in the aggregate amount of notes and bonds outstanding. For our particular group of plants there was, during the year 1914–15, an increase of stock issues to the extent of $368,300, and

[1] Though Mr. Forrest E. Barker, who was for nearly thirty years a member of the Massachusetts Board of Gas and Electric Light Commissioners, and for twenty years its chairman, died in 1914, the Board in its policies seems to have been little affected by this loss, — in fact it seems to be growing even more strict in its regulation.

[2] Mass., 1913, ch. 597.

[3] Mass., 1913, ch. 509.

[4] Mass., 1914, ch. 742, sect. 39.

a decrease in notes payable of $115,769, while the bond issues remained unchanged. This, upon the whole, surely indicates a healthy condition of finance.

2. Other Comparisons of Financial Results of Operation

Perhaps it will be of some interest to attempt a few additional comparisons of the financial results of operation in the two groups of plants. Accordingly, our first concern is to make the data, as nearly as may be, comparable. The accompanying tables (Tables 33, 34, 35, and 36) indicate the relations which exist.

In Table 33, we note that, when the street lighting income of the companies is deducted from the gross income, and when the taxes paid are eliminated, the comparable operating ratios are 66.8 per cent for the companies and 83.7, more than 25 per cent higher, for the municipal plants. The difference in favor of the former is even more marked if we omit the amount paid for salaries of corporation officials — an expense not incurred by the public plants.

Again, in Table 34, it appears that the comparable net income is nearly four times as great for the companies as for the municipal plants. Since, however, on account of their greater sales of current, the companies would be expected to have a larger net income, we can make an adjustment for this difference by assuming that they should have a net income in proportion to the extent of their business, 84 per cent greater than that of the other group. But, even when this allowance is made, we find that they still have an advantage of about $200,000 over the municipal plants, an amount equal to a little less than 4 per cent on their entire investment. Perhaps another slight adjustment should be made in order to allow for their lower expenses of production on account of greater size. To attempt this, however, might cause us to beg the whole question, because it is largely due to their greater effi-

TABLE 33. GENERATING PLANTS: COMPARISON OF FINANCIAL RESULTS OF OPERATION [1]

	Companies	*Municipal Plants*
Operating income	$1,417,235	$671,761
Deduct street lighting income	264,641	
Comparable income	$1,152,594	671,761
Operating expenses	$872,935	$562,643
Operating ratio	61.6%	
Deduct taxes	104,591	
Comparable (?) expenses (*a*)	$768,344	562,643
Deduct salaries of officers	48,200	
Comparable expenses (*b*)	$720,144	562,643
Comparable operating ratio (*a*)	66.8%	83.7%
Comparable operating ratio (*b*)	62.6%	83.7%

[1] Holyoke excluded in all of these tables.

TABLE 34. GENERATING PLANTS: COMPARISON OF FINANCIAL RESULTS OF OPERATION (*continued*)

	Companies	*Municipal plants*
Net income	$544,300	$109,118
Deduct street lighting income	264,641	
Total	$279,659	
Add taxes paid	104,591	
Comparable net income (*a*)	$384,250	109,118
Add salaries of officers	48,200	
Comparable net income (*b*)	$432,450	109,118
Kilowatt hours sold for all purposes except street lighting	20,944,853	11,394,749
Excess of sales of companies over sales of municipal plants	84%	
Expected net income of companies (84% more than that of municipal plants)	$200,777	
Advantage of companies (*a*)	183,473	
(*b*)	231,673	

TABLE 35. GENERATING PLANTS: COMPARISON OF FINANCIAL RESULTS OF OPERATION (*continued*)

	Companies	*Municipal plants*
Case (1)		
Actual disposal of net income:		
Comparable net income (*a*)	$384,250	$109,118
Comparable net income (*b*)	432,450	
Profit and loss income	$22,222	2,957
Total (*a*)	$406,472	$112,075
Total (*b*)	454,672	
Actual charges against net income:		
Interest	90,094	62,143
Depreciation	56,314	92,306
All other charges	23,415	8,096
Total	$169,823	$162,545
Surplus (*a*)	$236,649	*$50,470**
(*b*)	$284,849	
Per cent on capital stock ($2,964,600) (*a*)	8.0	
(*b*)	9.5	
Per cent on total investment ($5,284,275) (*a*)	4.5	*1.7†*
(*b*)	5.4	
Case (2)		
Assuming equal rate of depreciation (3%), add to company charges	$100,296	
Surplus (*a*)	136,353	
(*b*)	184,722	
Equivalent to per cent on capital stock of (*a*)	4.6	
(*b*)	6.2	
Equivalent to per cent on total investment of (*a*)	2.6	
(*b*)	3.5	
Case (3)		
Charging against municipal net income, sinking fund and maturing debt payments, as the Massachusetts Law prescribes:		
Sinking fund charges		$ 24,596
Bonds and notes paid		*55,797*
Total charges (including above)		$242,938
Deficit		$130,863
Per cent on total investment		4.5

* Deficit. † Loss.

TABLE 36. GENERATING PLANTS: COMPARISON OF FINANCIAL RESULTS OF OPERATION (*concluded*)

	Companies	*Municipal plants*
Case (1)		
Theoretical disposal of net income:		
Assuming that the same rate of depreciation (3%) is charged off in both cases and that the same rate of interest (4%) is paid on the *total* investment.		
Comparable net income (including profit and loss income (*a*)	$406,472	$112,075
(*b*)	454,672	
Charges against net income:		
Interest at 4 %	211,371	116,953
Depreciation at 3%	158,528	87,715
All other charges	23,415	8,096
Total	$393,314	212,774
Surplus (*a*)	13,158	*100,699**
(*b*)	61,358	
Per cent on total investment (*a*)	0.3	*3.4†*
(*b*)	1.2	
Case (2)		
Assuming only an equal rate of depreciation (3%) charged off in each case, but that interest is paid by municipal plants on their entire investment at the customary rate (4%).		
Charges against net income:		
Interest	$90,094	$116,953
Depreciation	158,528	87,715
All other charges	23,415	8,096
Total	$272,037	$212,774
Surplus (*a*)	$134,435	*$100,699**
(*b*)	$182,804	
Equivalent to dividend on total investment of (*a*)	2.6%	*3.4%†*
(*b*)	3.5%	

* Deficit. † Loss.

ciency that they reap the higher returns, for we have discovered that their rates are in the aggregate slightly lower than those of the public plants.

We may also, as in Table 35, compare the actual disposal of net income in the two cases, aside from dividend payments of the companies, whereupon it is evident that the comparable surplus of the private plants is from 4.5 to 5.4 per cent of the total investment, according to whether or no we make an allowance for officers' salaries. The public plants, on the contrary, are subject to a deficit of $50,470, so that the difference between the two is nearly $300,000. If, however, we assume the same rate of depreciation to be paid in each case, the advantage of the companies is reduced by about $100,000. On the other hand, if the current sinking fund and maturing debt payments be charged against the public plants, — as indeed they rightfully should be, since they are an actual outlay resulting from municipal ownership, — we must add more than $80,000 to the deficit of the latter, so that the spread between the two remains about as before.

Finally, if the same rate of depreciation be allowed in each case, as in Table 36, and if interest be computed upon the *entire* municipal plant investment, with no subtractions for sinking fund and maturing debt payments, we find that the companies still have a surplus of 2.5 to 3.5 per cent on their investment, while the municipal plants have lost an amount equal to 3.4 per cent of *their* investment. Furthermore, if the interest be computed at the lowest rate that would have to be paid by the companies (5 per cent), it would be necessary to add $30,000 to this deficit, whereby it would be raised to 4.5 per cent. Viewed from any angle, when the same tests, as nearly as may be, are applied to both, it appears that the financial efficiency of the companies, as measured by results, is considerably ahead of that of the other group.

3. The Cost of Street Lighting to the Municipalities owning their Electric Plants [1]

Much ink has been spilled in various vain attempts to prove or disprove the advantages of municipal ownership by a study of the rates which *are* charged, or which *might have been* imposed under private ownership, or which existed before the *change* in ownership was made. Many have appeared to think that if a municipality owning its plant happens to secure its street lighting for a little less than it would have paid to some private concern, public ownership is thereby demonstrated to be a success. Others, with no purpose except to make out as bad a case as possible for public business, have unreasonably included numerous imaginary items in the expenses which, as they assert should be charged against the current which the municipalities use for street lighting.

But, as has already been suggested, rates are but the uncertain reflections of the more fundamental elements in the problem. In themselves they may mean much or nothing; and they are usually misleading if we attempt from a superficial study to draw conclusions. Without a doubt, many items of expense which public plants are prone to overlook must be included, if we are honestly trying to discover what street lighting *really* costs, under municipal ownership, in the economic sense, as distinguished from what is *actually paid* in the commercial sense. Just where the line should be theoretically drawn, is a difficult matter to decide.

Now, we have found that the territory occupied by the companies is a much more difficult territory to serve than that of the public plants. They have been more liberal in their extension policy, and have legitimately incurred a much greater proportionate investment per customer than have the other group. All in all, since the character of the

[1] Cf. Mass. G. & E., xxxi: 304–306. See Appendix, pp. 454, 456.

business done seems to be not much different in the two cases, we might have expected somewhat higher rates in the companies than in the public plants. Yet, in spite of the considerations just mentioned, and in spite of the additional operating expenses due to taxes, salaries of officers, getting new business, rentals, *et cetera*, we have found their average rates somewhat lower, particularly when street lighting has been eliminated.

Under these circumstances, as the municipal plants appear to have given no advantage in the way of lower rates to their customers, and, in fact, in proportion to the service rendered, have charged noticeably more than the other group, we are justified in weighing against the street lighting account all of those charges actually incurred over and above the amount that can be met out of the net income. In addition, we should include some other items of cost, which, though not so obvious, are none the less real. The tables herewith given will indicate the results of some of the various methods of computations which may be employed.

TABLE 37. COST OF STREET LIGHTING TO MUNICIPALITIES OWNING THEIR GENERATING PLANTS [1]

Cost of street lighting as it appears from the returns:	
Net income from operation	$109,118
Other items of income	2,957
Total	$112,075
Charges against income	
Interest actually paid	62,143
Depreciation	92,306
Other cost items	8,096
Total	$162,545
Deficit in return for which street lighting is secured	$50,470
Number of K.W.H. used for street lighting	3,589,262
Apparent cost per K.W.H. (cents)	1.400
Price charged for street lighting by companies (cents)	7.575
Apparent gain per K.W.H. as a result of municipal ownership (cents)	6.175
Equivalent to (about)	$221,800

[1] Holyoke omitted throughout.

TABLE 38. COST OF STREET LIGHTING TO MUNICIPALITIES OWNING THEIR GENERATING PLANTS (*continued*)

Sinking fund and maturing debt payments included (since they are incurred as a result of municipal ownership):	
Total income available	$112,075
Total charges from preceding table	$162,545
Sinking fund payments	24,596
Note and bond payments	55,797
Total	$242,938
Deficit to be charged against street lighting	$130,863
Apparent cost per K.W.H. (cents)	3.640
Price charged by companies (cents)	7.575
Apparent gain (cents)	3.935
Equivalent to (about)	$140,400

TABLE 39. COST OF STREET LIGHTING TO MUNICIPALITIES OWNING THEIR GENERATING PLANTS (*continued*)

Add to deficit shown in Table 38 the taxes lost by municipalities owning their plants, computed at the same rate paid by companies:	
(*a*) Taxes at 0.428 (cents) per K.W.H. delivered	64,200
(*b*) Taxes at 12 per cent of operating expenses	76,724
(*c*) Taxes at 2 per cent on total investment	58,480
Deficit (*a*)	$195,063
(*b*)	207,587
(*c*)	189,343
Cost of street light per K.W.H. (cents)	
(*a*)	5.420
(*b*)	5.770
(*c*)	5.260
Gain per K.W.H. (cents)	
(*a*)	2.155
(*b*)	1.805
(*c*)	3.315
Equivalent to (*a*)	$77,600
(*b*)	64,800
(*c*)	82,800

TABLE 40. COST OF STREET LIGHTING TO MUNICIPALITIES OWNING THEIR GENERATING PLANTS (*continued*)

Same as Table 39:	
Except, to make the data comparable, add salaries of officers to expenses, computed at the same rate per K.W.H. delivered as in the case of the companies (0.200 cents)	$30,000
Equivalent to rate per K.W.H. used for street lighting of (cents)	0.830
Which, added to the above rates, makes the cost of street lighting per K.W.H. (cents)	
(*a*)	6.250
(*b*)	6.600
(*c*)	6.090
Total apparent gain to municipalities:	
(*a*)	$47,600
(*b*)	34,800
(*c*)	52,800

TABLE 41. COST OF STREET LIGHTING TO MUNICIPALITIES OWNING THEIR GENERATING PLANTS (*concluded*)

Interest computed on entire investment (at rate paid on outstanding debt):	
Total available income	$112,075
Charges against income:	
Interest (@ 4%)	$116,953
Depreciation	92,306
Other cost items	8,096
Total	$217,355
Add taxes lost (0.428 cents per K.W.H. delivered)	64,200
Total charges	$281,555
Deficit	$169,480
Cost per K.W.H. for street lighting (cents)	4.710
Gain over company rate (7.575 cents)	2.865
Equivalent to (about)	$101,100
In order to put the public plants on the same bases for comparison as the companies, we should deduct from this apparent gain:	
(*a*) Additional interest which would be paid under private ownership (1%)	29,238
(*b*) Salaries which would have been paid to officers.	30,000
Total	$59,238
Equivalent to rate per K.W.H. used for street lighting of (cents)	1.650
Making cost per K.W.H. (cents)	6.360
Apparent gain from municipal ownership of	$41,800
Equivalent to per cent on investment ($2,923,825) of	1.4+

In Table 37 are indicated the ordinary charges against net income, aside from sinking fund and note and bond payments, which were actually incurred during the year. From this simple analysis it would appear that the plants were subject to a deficit of only $50,470, which is equivalent to 1.400 cents per kilowatt hour used for street lighting, or 6.175 cents below the average rate charged for this service by the group of companies under consideration. This would be equal to an apparent saving of $221,800 as a result of municipal ownership. Unfortunately this is literally too good to be true.

Our next table (38) carries the analysis somewhat farther and includes the sinking fund and maturing debt payments, which are a current charge that must be met out of the tax levy if not out of income, and which would never have been incurred had not the municipality owned its plant. Having made this addition, we find that the deficit which might be considered the "cost" of street lighting, is increased to $130,863, and that the apparent saving under public ownership is $140,400.

If any one should ask what policy is to be pursued when the debt has all been paid off, the logical reply is that, so far as can be determined from our study of the situation, it is scarcely probable that a progressive plant will ever be debt free, unless it draws upon the tax levy for capital charges. There must be constant new investment in order to keep up with the progress of the arts and the growth of industry and population.

But thus far we have failed to make allowance for the fact that the public plants have not been paying the taxes which a private business would have paid. The income thus lost must simply be made good *by levying at a higher rate upon other private property*. Bricks cannot be made without straw: municipalities cannot be financed without funds. Expenses foregone should result in correspondingly lower charges for service under municipal ownership. Since we

have found this not to be the case, and since the rates appear to be comparatively higher for the public plants, it is logical to charge against the street lighting account the additional contributions made by the taxpayers — a burden of which they would have been relieved, had the electric plants been privately owned. *This* is very tangibly a part of the *real* cost to the community. Doubtless the principle here involved is too well understood to merit further comment.[1]

Accordingly, we have computed the taxes lost at the same rate as is paid by the companies (Table 39). This can be variously estimated at 0.428 cents per K.W.H. delivered, at 12 per cent of the operating expenses, or at about 2 per cent of the total investment, based upon the relative amount paid for taxes by the companies. Thus the deficit is increased by about $60,000 to $75,000, and the gain through decreased cost of street lighting as a result of public ownership, drops to about $75,000.[2]

But municipal light boards, selectmen, mayors and aldermen, municipal treasurers and auditors, not to mention others, have contributed to the municipal plants, with

[1] In England, and probably in Germany, surpluses earned by the municipal lighting department are frequently used for other public purposes, and thus effect a lowering of the tax rates. This, however, could not happen in Massachusetts. Cf. Mass., 1914, ch. 742, sect. 114.

[2] The computation based on the total investment makes the estimated taxes disproportionately small, due to the conditions of investment existing in the public plants, as previously discussed. Had the plants been privately owned, so far as we can judge from our study, taxes would have been secured on a considerably increased investment; hence the municipalities have lost relatively a greater sum.

Probably the percentage computation, 12 per cent of the operating expenses, is the closest approximation, and, though the figures thus reached are absolutely highest, the public plants really are given a considerable advantage, for without salaries of officers, etc., the taxes would form a comparatively higher portion of the total expenses.

The computed amount based on the rate per kilowatt hour delivered, is reasonably satisfactory, though probably too low, since, for obvious reasons, the unit cost for this item might tend to grow higher as the output of the plant becomes smaller.

little or no remuneration, the services which, in the companies, are performed by the salaried officers. This freely rendered service should be reflected in lower commercial rates, and, in lieu of that, the street lighting should cost correspondingly less. Hence another adjustment may be made for this item, estimated at the same rate paid by the companies, if we wish to find out how much the street lighting is *really* costing.[1] Having made this calculation, the "gain" of the public plants is further reduced to $35,000 or $45,000 — not a very princely sum (Table 40).

We may, however, approach the problem from another point of view, and in addition to the taxes lost we can include interest, at the customary rate, on the *total* investment, — not merely on the bonds and notes outstanding (Table 41). The resulting figures seem to indicate that the municipalities have saved about 2.865 cents per kilowatt hour on their street lighting, or in the aggregate somewhat more than $101,000. If the salaries which would have been paid to officers be also added, so that our standard of measurement may be kept unchanged from the point of view of operating efficiency, we must reduce this amount by about $30,000. And, finally, if allowance be made for the higher rate of interest which would have been paid under private ownership (at least 1 per cent) and which should also be reflected in lower cost of street lighting, we must make a further reduction of almost $30,000, so that the total advantage is slightly less than $42,000, or 1.4 per cent on the entire investment. Naturally the sinking fund and maturing debt payments are not included in this particular computation, for, since we have charged interest

[1] It makes no difference whether we deduct from the company rate, which is our standard of measurement, the saving in costs which theoretically *should* be effected in such cases as this — and then note the difference between this corrected rate and the actual municipal rate; or whether we simply add the item to the previously indicated cost of street lighting, and subtract the total from our standard, 7.575.

on the total investment, *that* would seem to amount to "paying interest on the debt already paid."

As to whether or not interest on the total investment should be included in such cases as this, where a considerable portion of the debt has been paid off and where another portion has been "borrowed" from the taxpayers in the form of "appropriations for construction," there has been much diversity of opinion. The writer, however, is clearly convinced that the position which he has taken is logically sound.[1] In order to find out what a service rendered by the public *really costs* in the *economic sense*, we must not lose sight of any of the capital involved in the production of that service. The mere fact that bonds and notes have been paid off through the tax levy, or even out of earnings, does not in any particular alter the fact that just so much capital has been invested by the public, on which a fair return should be earned — and this, in the present instance, would be expected to show itself in the lower cost of street lights. Even if the debt had been canceled out of earnings, it must still be remembered that the *customer* has contributed, yes, invested, his money, as a result of paying more for the service than that service cost the municipality. This does not at all mean that he would capitalize against the customers of a municipal plant past profits in operation. It *does* mean that, in computing the actual cost of street lighting, we must not let the higher charges to the consumer carry the street lighting account.

In practically all cases, as just stated, the investment in addition to that represented by the outstanding debt, has been created by means of appropriations from the tax

[1] The view herein held is confirmed by letters which the writer has received from New York Public Service Commission of the First District and from the Wisconsin Railway Commission. It is also consistent with the Massachusetts law regarding the cost of service of the public plants; and for nearly twenty years, the Massachusetts Board of Gas and Electric Light Commissioners has considered interest on the total investment in making its calculations.

levy either for construction or for the payment of maturing debt; hence the question is relieved of some of its complexity. The practice followed by some of the public plants of appropriating liberally from the tax levy for street lights, depreciation, and interest payments, and then appropriating from *earnings* for note and bond payments, is a naïve way of covering up the actual financial conditions. Instances of *bona fide* payment out of earnings are exceedingly rare except in the case of Holyoke.[1]

So far as the writer can determine, the case is not particularly affected, whether, on the one hand, to the customary charges against net income we add sinking fund and maturing debt payments as well as taxes lost (together with the theoretical item of "salaries of officers," in order to be exact), or, on the other hand, omitting sinking fund and debt payments, we include the interest on the entire investment. The latter position, however, would appear to be the more correct one.

What does the small advantage in the price paid for street lighting according to these computations really mean? In the light of our earlier investigations it signifies very little. In the first place, even this "profit" would probably be wiped out if we were to apply all along the line the same tests to the public plants as to the private plants. In addition to taxes and salaries of officers which have already been discussed, there would be interest on a higher and frequently much needed investment, together with a number of other operating charges. In the second place, we should *expect* the street lighting costs in the municipal plants to be much lower than in the other group, because of the longer number of hours' use of lamps per night (9.1 hours as contrasted with 7.6 hours), as well as because of

[1] So far as the writer is informed, the municipal plant of South Norwalk, Connecticut, is the only public plant which makes allowance for taxes lost, interest on total investment, and in addition a *reasonable return* on capital invested.

the more favorable territory served and the shorter lines per lamp (511 feet vs. 617 feet). But, on the other hand, many gains along other lines under private ownership might be cited. The tables show that the companies not only could have given absolutely free street lighting to their municipalities, but also that in addition they would have been able to make a considerable profit if put on the same basis as the public plants. There are also good reasons for believing that the *quality* of street lighting service rendered by the public plants is, in some instances at any rate, inferior to that demanded and secured from the privately owned plants.

However, it is futile to carry this discussion further. The results of our analyses in this chapter seem to indicate that the municipal plants in general have simply held their own financially, even though, in some instances, it may have been at the customer's expense. The *actual* "profit" which they are at present making is practically negligible.

Having made a similar study of the cost of street lighting for the year 1909–10, the writer finds that the conditions then were not greatly different from those met with in 1914–15. For earlier years it is difficult to secure accurate information, as the current was not usually metered.

Summary

The main points developed in the present chapter may be summed up as follows:

1. The interest rates paid by the municipal plants are from 1 to 1.5 per cent lower than the rates paid by the companies. The average rate of dividends paid by the latter are at present rather liberal, though probably not excessive, in view of the earlier low rates and complete absence of returns in several cases.

2. While the average depreciation allowances made by the companies in 1914–15 was relatively much lower than that made by the public plants, this year is found not to

be by any means typical. On the contrary, during the five-year period studied, the average rate charged off by the private plants was fully as high as that written off according to law by the other group. A few of the companies, however, have been very lax in this regard.

3. The average expenditures for repairs during the period 1910 to 1915 have been relatively, though not conspicuously, lower for the companies.

4. When put on a reasonably comparable basis, the financial showing made by the municipal plants is considerably less satisfactory than that made by the companies.

5. The only financial gain accruing to the communities owning their plants, is that they apparently secure their street lighting at a slightly lower cost per kilowatt hour than would otherwise have been the case. This gain, however, is too small to be of any consequence, when considered in connection with the facts as we now know them.

6. There does not seem to be any direct relation existing between the size of the municipal plants and the estimated financial gains accruing through a lower cost for street lighting.

Tentative Conclusion on the Financial Results of Public Ownership

Finally, so far as the *financial* aspects of operation are concerned, there seems to be little in the rates and less in the investment policy to cause us to feel optimistic on the subject of municipal ownership in the cases studied. Nor, on the other hand, have they apparently made any conspicuous failures, except in one or two instances.[1] They simply seem to have had the pleasure of doing for themselves, with slight tangible returns, what might have been done, and perhaps better done, by private enterprise. When we take into consideration the great loss which is certain to result when a number of the generating plants are junked and current is purchased from private con-

[1] Hull and Wakefield.

cerns, — a tendency which is at present well defined, both in the public and the smaller private plants, — the outlook is not reassuring.

True it is, in many cases considerations other than financial may be of the greater importance in questions of public ownership. To this aspect of the matter some attention has already been directed and further reference will presently be made. Yet we must not forget that a *commercial enterprise*, whether in private or in public hands, should normally meet both the physical and the financial tests. From the coldly practical point of view, if our public plants fail in either of these tests when compared with private industry, the burden of proof being naturally put upon them, they cannot be called a success. If it be contended that our decision should be based on more ideal and less tangible considerations, it may be suggested in reply that we are in danger of losing ourselves in a maze of uncertainties even greater than those at present encountered, as a consequence of attempting primarily to measure the results of commercial business by other than commercial tests. It is a question whether the demands of political expediency should normally ever outweigh the physical and financial efficiency in matters of this kind. And, surely, if the commercial tests fail, there must be some unusually urgent political or social motive in order to justify any change from private ownership.

CHAPTER VIII

FINANCIAL STATISTICS OF THE PURCHASING PLANTS

1. The Capital Account [1]

After the detailed analysis which has been made of the financial data of the two groups of generating plants, it will be possible to review rapidly the less important, but constantly increasing group of plants which purchase their current. The same methods of study will be followed as in the preceding case.

Accordingly, we find that it makes practically no difference whether we select as the total investment in the municipal plants, the aggregate liabilities created by the outstanding debt, and the appropriations from the tax levy for debt payments and for construction, or, on the other hand, simply use the gross plant cost as explained in the earlier chapter. The latter is only a fraction of one per cent higher than the former. Hence these figures have been chosen to compare with the total plant cost of our group of 16 companies.[2]

It appears from Table 42 that the total investment of the comparable companies is 56 per cent higher than that of the municipal plants, omitting Norwood, and that the average investment per plant is about two times as great in the former as in the latter, though their output of current is less than 70 per cent higher. This disparity is

[1] Appendix, pp. 466–467.

[2] The aggregate of the capital and loans of the private plants outstanding is a little too high (about $68,000), due to the fact that three of the companies, North Brookfield, Provincetown, and Randolph, are unincorporated and have issued an excess amount of stock, which has not been approved by the Board. When these exceptions are deducted, the capital and loan liabilities are almost equal to the cost of plant as carried in the construction accounts.

TABLE 42. COMPARATIVE INVESTMENT DATA (PURCHASING PLANTS)

	Companies (16)	*Municipal plants (20)* [1]
Total investment	$1,110,738 (905,060)[2]	$579,508
Average per plant	70,000 (60,337)[2]	$29,000
Net additions during year	$111,632	$42,680
New construction during year	111,632	53,567
Number K.W.H. delivered	3,221,028	2,428,240
Average per plant	201,314	121,412
Average purchased per plant	266,715	157,173
Connected load (K.W.)	7,793	6,638
Average per plant	487	332
Length of lines (miles)	1,100	1,458
Average per plant	68.7 (71.6)[2]	72.9
Number of poles per plant	750 (792)[2]	794
Investment per K.W.H. delivered (cents)	34 (30)[2]	24
Investment per K.W. connected load	$144 (128)[2]	$81
Investment per mile of line	$1,010 (843)[2]	$400
Percentage of total lines in commercial lines	68.6	65.7
Investment in commercial lines	$760,000(?)	$380,000(?)
Investment per customer	$126 (112)[2]	$66
Operating income (street lighting out)	$227,528	$150,884
Investment per dollar of operating income	$4.90 (4.70)[2]	$3.90
Total number of customers	6,021	5,776
Inhabitants of territory served	87,480	53,581

[1] Norwood omitted. [2] Manchester omitted, as all lines are underground.

caused, partially at any rate, by investment in dead assets. The fact that 6 of the public plants do not value their land, which is returned as "owned by the town," and that 6 others report no real estate whatever, helps to keep their investment disproportionately low, though real estate should not be a very significent item in the capital account of a distributing plant. But, from our earlier

study, it will be recalled that the municipal plants have, on the average, a somewhat more extensive distributing system, the investment in which might be expected to be sufficient to cancel the *lack of investment* in real estate. (In these comparisons it seems best to omit the company of Manchester, which has put $150,000 into underground construction — a rather large venture for so small a plant, but necessary in order to satisfy the "artistic" tastes of the people of the town.)

The figures here presented serve to show more clearly the truth of our earlier suggestion to the effect that the relations which exist between the two groups of purchasing plants are very different from those found in the case of the generating plants. This second group of companies do not seem to have given a good account of themselves either from a physical or from a financial point of view. They are, in the main, suffering under the financial burden which must always be borne by those electric plants which, after equipping themselves for the production of current, scrap their central station equipment and purchase current from others.[1] But even those which have never had generating equipment seem to have much less to show for their expenditures than have the municipal plants. To be sure, a larger investment can be expected in the former because their business is two thirds greater; yet for this very reason some of the data given make their case so much the worse. About all that can be said for the companies, since they appear to have by far the more favorable territory to serve, is that their investment per dollar of gross income approaches more nearly to the figure shown by the municipal plants than do any of the other data — and *this*, under the circumstances, is no particular cause for satisfaction. Finally, it must be remembered that 14 of this group of

[1] It will be remembered that only five of the group, Harvard, Ludlow, Manchester, North Brookfield, and Williamstown, began merely as distributing plants.

private plants are "controlled" — possibly with some degree of success!

Just a word should perhaps be said regarding the increase in investment during the year under consideration. It appears that the net additions to plant amounted for the companies to $111,632, or about 10 per cent of the entire investment, and for the municipal plants the net additions were $42,680, equal to nearly 8 per cent of the investment. Though the showing here made is more favorable for the former, it hardly seems sufficient to absolve them for their earlier financial blunders or to remove the effects of their financial misfortunes, if such we choose to regard them. On the other hand this apparently healthy policy of extension may indicate that, from the public point of view, the companies are now endeavoring to give a *quid pro quo*. However, when we compare the total increase in length of lines during the year, 116 miles for the companies and 132 miles for the municipal plants,[1] with the amount expended on new construction, $111,632 and $53,567 respectively, we find that the cost per mile of new line, since most of the increase legitimately belongs here, is still nearly $1,000 in the one group and about $400 in the other. The leopard does not seem to have changed his spots! There could scarcely be sufficient difference in the quality of the construction to justify the difference in expense.

The balance sheets show a small surplus for each group, $20,000 in the case of the companies and a little more than $30,000 for the public plants. Only two of the former and three of the latter return a slight deficit. The companies have financed themselves to the extent of two thirds of their investment by the issue of capital stock. The municipal plants, on the other hand, have secured about one third of their construction funds by means of direct

[1] The new plants of South Hadley, Lunenburg, and Paxton, accounting for an increase of 136 miles of line in the municipal group, must be omitted because their lines were not reported in 1914.

appropriations from the tax levy; and they have, by the same method, paid off a large portion of their bonds and notes, so that the actual outstanding indebtedness is now only $253,163 — less than one half of their total investment.

2. Operating Expenses and Operating Income [1]

The operating efficiency of the group of companies, when compared with the public plants, is far from what we might reasonably expect in view of their superiority in size. The only instance in which they appear to be effecting any considerable economies is in their distribution expenses. The better showing here made is due partially to their larger output of current, and partially, perhaps, to the character of their territory. It is also possible that they are not keeping their lines in as good repair as are the other group. Furthermore, the municipal plants are probably including here labor costs which should be charged to the construction accounts.

Many of the other important items of expense are conspicuously higher for the companies than for the public plants, and the difference is very marked in the case of general office expenses (under which the companies enter advertising expenses, etc.) and general salaries, where, presumably, it should be easiest to cut down the costs. If, however, the taxes paid be deducted, the two groups are put on a reasonably equal basis, so far as the total expenses are concerned. Some additional items should also be charged against the municipal plants, for the free services which they receive from town officials, or, instead of this, we might deduct the salaries of officers in the other group. Free quarters in the town hall are an important item. It is also significant that only 9 out of the 20 public plants are paying insurance, though the average rate paid by the group is almost as high as that paid by the companies.

[1] Appendix, pp. 468–475.

TABLE 43. COMPARATIVE EXPENSES PER K.W.H. SOLD (PURCHASING PLANTS)

	Companies (cents)	*Municipal plants (excluding Norwood) (cents)*
Total	6.318	5.890
Current purchased	3.577	3.780
Distribution (total)	0.821	1.500
Distribution wages	0.270	0.490
Maintenance and repair of lines	0.485	1.000
Per mile of line	$14.20	$16.50
Per cent of total investment	1.6	4.2
General salaries	0.376	0.265
General office expenses	0.452	0.194
Insurance	0.133	0.109
Taxes	0.410	...
Salaries of officers	0.219	...
Total management and miscellaneous	1.920	0.700
Total — taxes deducted	5.908	5.980
Total — taxes and officers' salaries deducted	5.769	5.980
Operating ratio (street lighting out)	90.	96.
Operating ratio (taxes out)	84.	96.
Total operating expenses	$203,492	$145,202
Total — taxes deducted	190,340	
Total — officers' salaries deducted	183,285	145,202

It is surprising to find so close a correspondence in the unit income of the two groups of plants. The companies seem to make up by means of higher lighting rates the concessions which they give to their power customers. In view of the better character of their business and the larger income per customer, their rates are probably too high, if we accept as our standard the municipal plants, which are apparently giving good service at low cost, though many of their customers would seem to be unprofitable. It should not be forgotten that the former find it necessary to be

TABLE 44.. PERCENTAGE ANALYSIS OF EXPENSES (PURCHASING PLANTS)

Character of Expense	Companies		Municipalities		Norwood
	Amount (dollars)	Per cent of total	Amount (dollars)	Per cent of total	Per cent of total
I. Operating expenses — General analysis:					
"At station"	$6,054	3.0	$1,671	1.2	0.1
Purchase of current	115,161	56.6	91,878	63.3	80.0
Distribution	26,435	13.0	36,371	25.0	11.2
Office expenses and management	34,825	17.1	12,476	8.6	7.8
Miscellaneous	7,865	3.9	2,807	1.9	0.9
Taxes	13,152	6.5	....	....	....
Total	$203,492	....	$145,203	100.	100.
Total — without taxes	190,340	....	....	....	....
II. Operating expenses — Detailed analysis, taxes out:					
"At station"	6,504	3.2	1,671	1.2	0.1
Current purchased	115,161	60.6	91,878	63.3	80.0
Distribution wages	8,805	4.6	10,047	6.9	3.2
Repair of lines, meters, etc.	15,607	8.2	24,165	16.6	7.0
Distribution tools and equipment	2,023	1.1	2,159	1.5	1.3
General salaries	12,123	6.4	6,430	4.4	5.0
Salaries of officers	7,055	3.7	....	....	....
Directors' allowances	1,074	0.6	....	....	....
Salaries of municipal light boards	....	....	263	0.2	1.2
General office expenses	14,560	7.7	4,720	3.3	1.8
Insurance	4.296	2.3	2,639	1.8	0.5
Rent of offices	2,246	1.2	683	0.5	....
All other	1,333	0.7	548	0.4	0.3
III. Operating income	$287,560	....	$151,556	....	....
Profit and loss income	11,928	....	1,631	....	....
Total	$299,478	....	$153,187	....	....
Total charges against income:					
Operating expenses	$203,492	67.3	$145,202	75.6	84.6
Interest	24,302	8.0	9,845	4.9	3.3
Depreciation	17,565	5.8	16,106	8.4	6.2
Sinking fund payments	....	....	280	0.2	....
Note and bond payments	....	....	20,997	10.9	5.9
Dividends	51,657	17.1	....	....	....
All other	5,341	1.8	92	0.1	....
Total	$302,357	100.	$192,022	100.	100.
Deficit	2,879	....	38,835	....	....

earning a fair return on a much larger investment; but this consideration should cause them to effect greater savings in their operating expenses.

Table 45. Maximum Net Rates per K.W.H. (Purchasing Plants, 1910 and 1915)

Municipality	Light		Power		Company	Light		Power	
	1910 (cents)	1915 (cents)	1910 (cents)	1915 (cents)		1910 (cents)	1915 (cents)	1910 (cents)	1915 (cents)
Ashburnham	15.0	10.0	10.0	5.0	Ayer	18.0	15.0	13.7	5.0
Belmont	12.0	10.0	10.0	10.0	Blackstone	15.0	14.0	...	10.0
Boylston	...	12.0	...	8.0	Franklin	12.0	9.9	5.0	5.0
Georgetown	...	12.0	...	7.0	Harvard	...	17.0	...	5.0
Groton	16.0	11.7	...	5.0	Ludlow	12.0	12.0	5.0	5.0
Groveland	15.0	11.0	15.0	11.0	Manchester	15.0	15.0	15.0	15.0
Hingham	11.0	10.0	?[1]	10.0	Milford	19.0	14.0	10.0	5.0
Holden	...	12.0	...	6.0	Mill River	15.0	15.0	?	6.7
Littleton	...	13.5	...	13.5	North Brookfield	...	15.0	...	7.2
Lunenburg	...	12.0	...	5.0	Provincetown	15.0	18.0	...	10.0
Middleton	...	15.0	...	...	Randolph	13.0	13.0	13.0	13.0
Norwood	15.0	9.0	12.0	?[2]	Shirley	...	15.0	...	4.5
Paxton	...	12.0	...	8.0	Spencer	20.0	18.0	...	8.0
Princeton	...	10.8	...	...	Sunderland	20.0	13.5	...	6.0
Rowley	...	12.5	...	12.5	Ware	20.0	15.0	8.0	7.2
Shrewsbury	15.0	10.8	...	5.0	Williamstown	13.5	12.0	4.0	5.0
South Hadley	(14.25)[3]	13.5	(9.5)[3]	9.5					
Sterling	...	10.0	...	6.0					
Templeton	15.0	11.0	10.0	8.0					
Wellesley	10.8	8.5	8.1	5.1					
West Boylston	...	12.0	...	4.0					

[1] Hingham had special power rates.

[2] Rate varies with demand.

[3] Under private ownership.

TABLE 46. COMPARATIVE INCOME (PURCHASING PLANTS)

	Companies	*Municipal Plants (excluding Norwood)*
A. Income per K.W.H. (cents):		
Total operating income	8.928	9.090
Total (street lighting out)	8.945	9.090
Total from sale of current	8.723	9.070
Total (street lighting out)	8.700	9.070
Commercial lighting	12.418	10.387
Street Lighting	8.870	...
Power	3.754	5.635
B. Other comparisons:		
Net income	$84,069	...
per K.W.H. sold (cents)	2.610	...
Net income (street lighting out)	$24,038	$6,353
per K.W.H. sold (cents)	0.946	0.380
Number of lighting customers	5,961	5,718
Number of power customers	305	309
Income per lighting customer	$30.40	$23.25
Income per power customer	$123.10	$40.80
Income per kilowatt connected load:		
Light	$33.60	$23.60
Power	$16.20	$14.50
Total operating income	$287,560	$151,556
Total income (street lighting out)	$227,529	$151,556
Profit and loss income	11,918	1,631

3. DISPOSAL OF NET INCOME: COMPARISONS [1]

Nine of the municipal plants suffered some loss in operation, while the net gain for the group was a little more than $6,000. Of the private plants, if the street lighting income were to be omitted, 6 would have been operated at a loss.

The amount of depreciation written off during the year is not far apart in the two cases, 0.661 cents per kilowatt hour in the municipal plants and 0.545 cents in the companies, though 7 of them did not make any allowance for this item. Judged by the ratio which the amount of depreciation bears to the total investment the rate allowed

[1] Appendix, pp. 476–477.

by the latter would appear to be too small. Since, however, it is probable that in many instances a good portion of their property has been "junked," they are not liable to serious criticism. The assessed valuation, it must be remembered, is little more than half the "total investment" as we have taken it.

The dividends declared amounted to more than $50,000, 7.4 per cent on the capital stock, and 4.7 per cent on the investment, swollen though it be.[1] After all charges were met, there was a deficit for the year of about $3,000.

Had the companies given free street lighting service, and had they not paid taxes, they would have had at the end of the year a net income of nearly $40,000, about half of which would be accounted for by the company of Manchester. This sum would be just enough to meet the depreciation and interest charges. The municipal plants, on the other hand, can show an operating surplus of only $6,000. Other comparisons might be made, though it appears that the financial advantage in operation of the private plants is accounted for chiefly by their larger business. Their total income exceeds that of the other group by an amount proportionately equal to the difference in quantity of current sold.

4. The Cost of Street Lighting [2]

An attempt has been made to compute the cost of street lighting by a method similar to that employed in the preceding chapter, of which no further explanation need here be given. It is evident that, if we consider only the actual outlays during the year resulting from public ownership, allowing for the taxes lost at the same rate paid by the companies, there has been an aggregate saving of about $16,100, or less than 3 per cent on the investment. If, in

[1] Three of them, Harvard, Ludlow, and Sunderland, did not earn enough to pay dividends.

[2] Appendix, p. 478.

addition the appropriations from the tax levy for new construction were to be counted, this apparent gain would be more than offset.

TABLE 47. COST OF STREET LIGHTING TO THE TOWNS OWNING THEIR DISTRIBUTING SYSTEM

I	Net income from operation	$6,353
	Other income	1,631
	Total	$7,984
	Charges against income:	
	Depreciation	$16,106
	Interest paid	9,345
	Taxes lost (estimated at 0.41 cents per K.W.H. delivered)	9,963
	Other items	92
	Debt payments	23,777
	Total	$59,283
	Deficit	51,299
	Number of K.W.H. used for street lighting	760,923
	Cost per K.W.H. (cents)	6.750
	Rate charged by companies	8.870
	Apparent saving per K.W.H. (cents)	2.120
	Equivalent to (about)	$16,100
II. A.	Available income from all sources	$7,984
	Charges against income:	
	Depreciation	$16,106
	Interest on entire investment @ 4%	23,180
	Taxes lost	9,963
	Other items	92
	Total	$49,341
	Deficit	41,357
	Apparent cost of street lighting per K.W.H.	5.435
	Apparent saving per K.W.H.	3.435
	Equivalent to (about)	$26,100
B.	Commercial lighting rate of companies (cents per K.W.H.)	12.418
	Commercial lighting rate of public plants	10.387
	Apparent gain under municipal ownership (cents per K.W.H.)	2.031
	Number of kilowatt hours used for commercial and domestic lighting in municipalities owning plants	1,279,932
	Aggregate saving	$26,000
	Making an apparent total gain of	$52,100
	and actual (?) cost of street lighting	$15,250
	Equivalent to a rate per K.W.H. (cents)	2.000
	A saving per K.W.H.of (cents)	6.870

According to the other method, when interest is computed upon the entire investment and maturing debt payments are omitted, the cost would seem to be somewhat lower, about 5.435 cents per kilowatt hour instead of 8.870 as in the companies, and the advantage arising under public operation might be said to be about $26,100, somewhat more than 4 per cent on the plant cost. Most of this surplus would be absorbed, were we to give due consideration to the free services of various kinds rendered by the towns, as well as the lower interest rates which result from the credit of the municipality.[1] These advantages, however, should, and probably *have* resulted in lower charges for commercial service than might otherwise have been secured. Hence, as indicated in the table (47, II, B) these municipalities seem to be getting their street lighting at a very low rate indeed.

From the foregoing brief analysis, so far as the statistics can show, it appears that this group of little public plants have been operated with a considerable degree of effectiveness. Though they have just about broken even financially, they have certainly justified their existence by giving comparatively low commercial lighting rates. Supported by the hearty coöperation of the communities in which they are located, assisted at all times by the Commissioners, they have been able to render their consumers at a reasonable rate that service for which private enterprise would probably have expected a much more liberal reward. Dependent on private enterprise for the solution of the more technical problems connected with the generation of current, they have been able, at a merely nominal outlay, to find public spirited citizens who are willing to devote a large part of their time to "managing" the municipal plants, and doing a little of every kind of work for which private concerns would have to pay dearly.

[1] The average rate paid by the small public plants is close to 4 per cent, while this group of companies pay usually 5.5 per cent.

Addendum: Perhaps it should be suggested in this connection that, after having studied the local situation with some care, the writer feels that the preceding statistical analyses may in some ways tend to be misleading in regard to this group of municipal plants.[1] In the first place, the investment in useless equipment, amounting to something less than $200,000 as nearly as can be estimated, should be deducted from the total investment of the companies in order to put them on a reasonably comparable basis with the public plants in so far as present-day financial efficiency is concerned. This would reduce all of their investment data by more than 20 per cent.[2] Accordingly, we find that, with this adjustment, the investment per kilowatt hour delivered is only 22 cents for the private plants, instead of 30 cents. Also, the investment per dollar of operating income, street lighting excluded, becomes only $3.10 in the companies as contrasted with $3.90 in the other group. And the average investment per plant, then, is by no means out of line with the relatively greater amount of current sold.

Again, not only do a large proportion of the municipal plants own no real estate or buildings of any kind, as previously stated, but also as the current is metered at the town line and frequently transformed by the selling company, they are saved the expense of large transformers and transformer sheds, etc. Their investment is in lines alone, while the companies naturally have a good deal of money in land and buildings.

In a number of cases, also, the line construction of the smaller municipal plants is reported to be below the standard which is common with the other group. This fact may partially explain the much higher cost of recent extensions per mile of line in the private plants.

Finally, it has been found that, in many instances, when extensions are made, the cost of labor and superintendence

[1] Cf. ch. xiii, *infra*.

[2] Manchester omitted.

which is properly chargeable to the construction account has in the municipal plants been treated as an operating expense. Though every influence is exerted to keep the capital accounts low in the public plants, the tendency is wholly in the opposite direction in the private plants, for reasons which it seems scarcely necessary to comment upon. Hence, this policy has operated to make the comparative investment much lower in the former than in the latter.

If all of the foregoing factors could be properly evaluated, it is probable that the disparity between the two groups would not be so noticeable, though the companies would still be under a disadvantage. And, so far as the operating expenses are concerned, it must also be recalled that practically all of the public plants are so new that there has been very little replacement or renewal of the distributing system needed, while the cost of upkeep has been almost *nil*. In a few years the turning point will come when we can look for a greatly increased unit cost of operation, in spite of the fact that practically nothing is being paid for management.

Summary

The results of our study of the financial conditions of these two groups of purchasing plants may be briefly stated as follows:

1. There appears to be far greater economy in investment in the municipal plants than in the companies. In this connection, however, we must remember (*a*) that the latter, having for the most part formerly generated current, have an unavoidably large investment in "dead assets." Also (*b*) the tendency of these small *public* plants is to keep the *apparent* investment account low, and to include in operating expenses what is really a capital charge.

2. The companies seem to have an unnecessarily high

unit cost of operation, as compared with the other group; but the municipal plants receive a good deal of *unpaid* or *under*-paid service, and on account of their recent installation the cost of upkeep is at a minimum.

3. Though the public plants appear to have the less desirable territory to serve, their *average* income per kilowatt hour sold is practically the same as that of the companies. The *lighting* rates of the former are lower (about 10 per cent), while their *power* rates average very much higher (50 per cent) than the corresponding rates of the private plants.

4. This group of municipal plants, with the exception of Norwood, does not seem to have made any direct financial gains. However, there is little question that the rates charged are in general lower than those which would have been charged by private plants, had they been in the field. Whether this will continue to be the case, after the "seasoning" period is passed, is an open question.

5. The public plant of Norwood, during the year 1914–15 at any rate, made a better financial showing than any other municipal plant of either group. It appears not only to have given the town *absolutely free street lighting*, but also, in addition, to have made a little money in operation ($255), after all possible charges have been allowed for. It must be recalled, however, that the local conditions and the business are unusually favorable.

CHAPTER IX

MISCELLANEOUS CONSIDERATIONS

1. Labor and Wages [1]

Having examined at some length those aspects of our subject which can be most readily measured in terms of physical units, we must devote brief attention to several other considerations, more difficult to evaluate, but none the less highly significant. Many students of the problems of municipal ownership are particularly concerned about the questions which relate to the employment of labor. Frequent assertions are made to the effect that public labor is less efficient than private labor, not to mention the possibilities for political corruption. Accordingly, before discussing the information secured in the local survey, it will be of interest at this point to attempt a few comparisons of the conditions which are indicated from our study of the returns of the two groups of plants.

In no respect are the accounts prescribed by the Board less satisfactory for our purposes than in the data which they require regarding employees and wages. While the "average number of employees" for the year — whatever the "average" may be — is given by both groups, only the *public* plants are compelled to return the wages which they pay. For the companies, however, the salaries of officials are given, and it is possible in a very crude sort of way to estimate, in part, the average wages per employee, by comparing the number reported with the outlays for wages appearing under the different heads "wages at stations," "distribution wages," and "general salaries." But there is constant overlapping, and, particularly in the

[1] Appendix, p. 458.

case of the linemen, no accurate data can be secured, for costs of material and labor are lumped together in the item "repairs and renewals of lines, etc."

Other difficulties, however, present themselves because of the lack of consistency and uniformity in the methods which are followed in determining the average number of employees. In many cases no line is drawn between regularly employed labor and occasional labor, or between full-time and part-time employees. Nor does any clear distinction seem to be made between labor which is used on new construction, the wages of which would be charged to the capital account, and labor which is employed in the operation of plant. The growing policy of "jobbing" certain portions of the work, — even in the case of repairs, — which is found in some of the larger companies, also tends to obscure the relations which exist between the number of employees and the operating labor costs.

Again, in many cases, wages are returned under a certain head, with no report of a corresponding number of employees; while frequently a number of employees are listed, though no wages appear for them in the operating accounts. Some plants, both public and private, which are doing a large business, report no clerks or bookkeepers whatever. On the other hand, one small purchasing plant boasts of one clerk at the local office and *two additional clerks in Boston!* The municipal plants frequently report none of their female employees, because the return form *literally* calls for the number of *men* employed! Such are some of the puzzling problems which present themselves.

However, after having checked up the returns with great care, the writer finds that, while there are numerous additions and omissions in each group, the generating companies in the aggregate returned about 6 per cent too many employees, even though we include among the list those officers of corporations who really do some work and whose salaries are partially distributed under other

heads than "salaries of officers." Hence the total number, corrected, excluding those officers who do not appear to be directly connected with the actual operation of the business, is 295 (17.4 per plant), instead of 313 as reported to the Board. The corresponding public plants, on the contrary, appear to have reported about 4 per cent too few employees, so that their corrected number, including the managers, is about 240 (14.1 per plant) instead of 230. Since the possibility of error in 1910 would in both cases probably be about the same as in 1915, the uncorrected figures will be used in making comparisons with that year.

It appears that the total number of employees has increased just twice as rapidly for the companies as for the municipal plants, though the figures were close together in 1910. The close correspondence at the earlier date, waiving the possibility of inaccurate returns, was probably in large measure due to the fact that, though their actual business was considerably greater than that of the other group, their distributing system was not proportionately so extensive. And, so far as the number of employees at station is concerned, the difference in size here found does not appear to be particularly significant. (This, by the way, is very obvious in the 1915 figures, for the total number of station employees in the two groups is respectively 110 and 103.) Furthermore, the public plants in 1910 seem to have been just completing one of the stages of their growth, whereas the companies, for the most part, appear to have been entering upon a period of rapid expansion.

The marked increase shown by the companies during this period has not been incommensurate with the growth of their business and the extent of their lines. The rapid development of their distribution system, their increased commercial lighting service, and their evident efforts to serve *all* of the public, have naturally necessitated the use of a proportionately larger force of employees. Yet they

are probably somewhat "over-staffed" at present; while the municipal plants, though they would not be expected to increase the number of their labor force as rapidly as their business, are doubtless getting on with as few employees as possible, depending in many instances upon the practice of hiring "extra help as required." However this may be, it is gratifying to find that there is no evidence of "making work" for municipal employees, if we may take as our criterion the condition found in the group of companies.

TABLE 48. COMPARATIVE EFFICIENCY OF LABOR

Item	1910		1915		Per cent increase	
	Company	Municipal [1]	Company	Municipal [1]	Company	Municipal
I. Generating plants:						
Total number of employees	194	179	313	230	61.4	30.0
Corrected for 1915	....	....	295	240	....	....
Number of salaried officers	....	....	33	....	....	....
Number K.W.H. delivered per employee	74,616	49,071	78,077	65,044	4.6	31.1
Corrected for 1915	....	....	82,008	62,469	....	....
Including salaried officers	....	....	74,500	....	....	....
Operating income per employee, excluding street lighting	$3,904	$2,477	$3,682	$2,915	−5.7	+17.1
Corrected for 1915	....	....	$3,868	$2,800	....	....
Including salaried officers	....	....	$3,514	....	....	....
Net income per employee, excluding street lighting	$600	$320	$894	$474	....	....
Corrected for 1915	....	....	$948	$455	....	....
Including salaried officers	....	....	$853	....	....	....
II. Purchasing plants:						
Total number of employees	....	....	58	46	....	....
Corrected for 1915	....	....	52	....	....	....
Number K.W.H. delivered per employee	....	....	55,536	52,788	....	....
Corrected for 1915	....	....	(62,000)	....	....	....
Operating income per employee, excluding street lighting	....	....	$3,920	$3,280	....	....
Corrected for 1915	....	....	(4,376)	....	....	....
Net income per employee, excluding street lighting	....	....	$344	140	....	....
Corrected for 1915	....	....	(384)	....	....	....

[1] Holyoke and Norwood omitted throughout on account of their size.

When, however, we compare the sales and income per employee at both dates, we find the companies far in the lead, after street lighting sales have been deducted, even though the salaried officials be included. But, obviously, they should *not* be counted if we are trying to put the plants on a comparable basis from the point of view of operating efficiency — unless, of course, we wish to regard as employees of the public plants a number of town officials together with the members of the municipal light boards. Yet it appears that while the income per employee of the public plants has increased to an appreciable extent, that of the companies has actually been subject to a slight decrease. While this state of affairs speaks well for the former, yet in view of what we have previously discovered regarding the physical and developmental features of the two groups, the showing here made affords no cause for elation.

The amount of current delivered per employee has increased in both groups, but far more rapidly in the public plants, as they have been growing up to their earlier equipment and labor force. The growth in amount of net income per employee, when street lighting income is eliminated, has been at an equal rate (50 per cent) for both. And probably the net income, which is twice as great in the companies, is the most significant consideration from the point of view of those who are in the business.

Mere size, in the aggregate, plays some part in causing the differences which have been observed, and the influence of this element was particularly noticeable in 1910. The number of employees should not by any means ordinarily increase *pari passu* with the growth in quantity of current sold, other conditions remaining equal. But, in this particular, as in others, the development seems to come by stages, rather than according to any fixed law. Finally, viewed from all angles, we find a higher labor efficiency in the purchasing companies than in the similar

municipal plants, and the advantage is almost as marked as in the other group.

As a result of the numerous difficulties which have been suggested, it has been no small task to put the wage data on a comparable basis.[1] However, by a process of inter-

TABLE 49. RELATIVE WAGES

Employees	Number		Total amount of wages and salaries		Average wages or salaries	
	Companies	Municipal [1]	Companies	Municipal	Companies	Municipal [1]
I. Generating plants:						
Total number employees on pay-roll (linemen excluded, officers included)	234	165	$231,230	$161,554	$988	$979
Number of salaried officers	33	....	48,201	....	1,461	....
Number of municipal managers	....	17	....	28,600	....	1,682
Total (excluding officers)	201	165	183,030	161,554	911	979
Total (excluding municipal managers)	201	148	183,030	132,954	911	898
Employees at station	110	103	114,590	109,048	1,042	1,059
Employees other than at station or linemen — mostly clerks, etc. (municipal managers included)	91	62	68,440	52,506	752	847
Ditto (excluding municipal managers)	91	45	68,440	23,906	752	531
Linemen (municipal)	....	....	....	....	....	(925)
II. Purchasing plants:						
Total number of employees (linemen excluded, officers included)	59	30	27,983	16,477	474	549
Number of salaried officers	19	....	7,055	....	371	....
Number of municipal managers	....	20	....	11,099	....	555
Total (excluding officers)	40	30	20,928	16,477	523	549
Total (excluding municipal managers)	....	10	....	5,378	....	538

[1] Holyoke and Norwood omitted from the public plants.

pretation and elimination it has been possible to arrive at an approximation of the truth. When linemen and repair men of all kinds are deducted, the wages of the remaining employee, particularly in the generating com-

[1] On account of the rapid and highly irregular changes taking place since the outbreak of the war, the wage data secured through the local survey are not of much value. Hence no attempt is made to use them here.

panies, will be found almost wholly in the items of "station wages," "distribution wages," and "general salaries" (plus salaries of officers in the case of the companies). While there will be a good deal of overlapping, especially in the smaller plants where one or two men do all of the work, the condition will probably be about the same in each group. It is also possible to find out exactly (so far as the returns are concerned) the number of men employed at the station itself as firemen, engineers, oilers, tenders, and the like. Having reached this point, we can determine, though with a much less degree of accuracy, the wages of the "soft-handed" laborers, the so-called "salaried" employees.[1]

[1] The writer has secured some data from the Bureau of the Census at Washington, which have never been published, but which appear so untrustworthy in certain respects that they have not been used in this connection. The averages which have been worked out from these data, are, however, appended in the following table:

TABLE 50. COMPARATIVE WAGES FOR ALL PLANTS IN MASSACHUSETTS

Item	1902		1907		1912	
	Companies	*Municipal*	*Companies*	*Municipal*	*Companies*	*Municipal*
Number of stations	97	17	96	24	87	30
All employees	1,894	130	2,448	224	3,630	324
Average income	$793	$671	$844	$756	$750	$796
Officers of corporations	112	....	122	....	148	....
Average salary	$1,275	....	$1,562	....	$1,514	....
Salaried employees	308	39	473	60	759	85
Average salary	$992	$590	$1,003	$671	$870	$714
Average salary (including officers)	$1,067	....	$1,091	....	$976	....
Wage-earners	1,474	91	1,853	164	2,723	239
Average wages	$715	$706	$766	$787	675	$826

The apparent decrease in average wages paid by the companies since 1907 seems hardly consistent with the facts. Probably the discrepancy is due partially to the different methods followed in reporting the average number of employees at the different dates. (In 1912 the number actually on the pay-roll on September 16th was called for, while only the

It accordingly appears, from the accompanying table, that the station wages, of which we are practically certain, are surprisingly close together in the two groups. The total wages paid per employee, when the officers of corporations are excluded, are somewhat higher in the public plants, though otherwise they are not far apart. Also, the wages for other than station labor are considerably higher than in the companies. If the municipal managers be eliminated, the salary of the remaining group, mostly clerks and helpers, is ridiculously low, — from which we would infer that a number are on part-time employment. No such separation can be made for the companies, though the conditions are doubtless about the same, unless, as is scarcely probable, in view of the services rendered by the salaried officials the wages of managers and superintendents happen to be cut down.

The figures for the purchasing plants suggest some rather surprising conditions, for it appears that the reported number of employees, divided into the returned amount of wages paid, would give each one less than a living wage. There is little to choose between the two groups, however, and the seemingly low wages are caused by the fact that most of the labor is employed on a part-time schedule. Of the municipal plants, nine report no regular employees, aside from the manager, and of the managers themselves, two receive no salary.

average for the year was given at the earlier dates.) It is noticeable that the average income of the so-called "salaried" employees in the municipal plants, including the managers, is not only much lower than the average salaries paid by the companies, but is also far below the average wages paid to the "hard-handed" employees. This would indicate that managerial wages were small, indeed, in the earlier days, since about two fifths of those on salary at the various dates were managers of municipal lighting. The wages reported by the companies, however, are in 1912 much lower than those paid by the public plants — a condition which does not now seem to exist. There is little doubt that many part-time workers have been included, though it is not evident why this error should have been greater in the one group than in the other, unless because of the higher number of workers employed by the private plants.

As to the general aspects of the labor problem in so far as it relates to our study of the electric lighting industry, it is not possible to draw definite conclusions. Probably, however, as a result of some of the recent labor legislation, the municipal employees may have some advantage over the laborers employed by the companies. Many of them have the eight-hour day,[1] two weeks' vacation annually,[2] and a half-holiday on Saturdays.[3] The Work-

TABLE 51. ADOPTION OF LABOR LEGISLATION (CLOSE OF 1916)

Action of the municipalities studied regarding recent labor legislation	*Municipalities owning plants (39)*		*Municipalities served by companies (33)*	
	Number taking action	*Per cent of total*	*Number taking action*	*Per cent of total*
I. Workmen's Compensation (Mass., 1913, ch. 807).				
Accepted	33	85	31	94
Rejected or no report	6	15	2	6
II. Pensions for employees (Mass., 1912, ch. 503)				
Accepted	28	72	25	76
Rejected	11	28	8	24
III. Eight-hour day (Mass., 1909, ch. 514, sect. 42, and Mass., 1911, ch. 494)				
Accepted	18	46	22	67
Rejected or no report	21	54	11	33
IV. Vacation for employees (Mass., 1914, ch. 217)				
Accepted	24	62	25	76
Rejected	15	38	8	24
V. Saturday half-holiday (Mass., 1914, ch. 688)				
Accepted	24	62	24	73
Rejected or no report	15	38	9	27

man's Compensation Act has been generally adopted by the municipalities studied,[4] while a large proportion are

[1] Mass., 1909, ch. 514, sec. 42, and 1911, ch. 494.
[2] Mass., 1914, ch. 217.
[3] Mass., 1914, ch. 688.
[4] Mass., 1913, ch. 807.

providing for pensions to their employees.[1] Private labor does not have all of these advantages, and sometimes longer hours are worked, as there is little if any unionization among the workers in this industry in the smaller places which have been investigated.[2]

It is interesting to note in this connection the apparent effects of municipal ownership upon the adoption of the progressive labor legislation just mentioned. Based upon an examination of the "Acceptances" filed with the Secretary of the Commonwealth, the writer has been able to make a comparison between the two groups of plants with respect to the action which they have taken. (The data are for the close of 1916.) While it may be merely a coincidence, it is noticeable that in every case the municipalities having *private* ownership have more readily adopted this recent labor legislation. On the other hand, the cities and towns owning their plants have been particularly backward about voting for the eight-hour day and the vacations, which would, in many cases, necessitate an increased expenditure for the operation of their lighting plants.

2. Valuation of Estates and Tax Rates [3]

A. Municipalities served by Generating Plants

Frequently it is asserted that public ownership of such an industry as the electric light and power business is not conducive to the growth of a community, first, because little effort is exerted to attract new enterprises, no inducements are offered, and no risks run; and, secondly, because the already established concerns are often shabbily treated. There is no doubt that a public plant can with impunity adopt a policy which would prove highly

[1] Mass., 1912, ch. 503.

[2] Cf. Mass. Labor Bulletin, No. 114, 1915, pp. 84–85. Cf. also ch. XII, *infra*. Appearances are sometimes deceptive.

[3] Appendix, pp. 424–425.

disastrous if attempted by a private concern. Yet, if our group of public plants (those generating current are here referred to) had followed a conspicuously mistaken policy in this regard, we might expect a slower growth in the population of the districts served, — which, by the way, has not been the case during the past five years, — and, in lieu of that, we might at least have looked for a less rapid increase in the total valuation of property in the places served by them than in the territory supplied by the corresponding group of private plants. Our figures, however, indicate that the growth in assessed valuation of estates has gone on at equal pace in both cases, 35 per cent for the companies and 34 per cent for the municipal plants.

It is rather interesting to note that the *per capita* valuation of estates is 34 per cent higher ($1,171) in the territory served by the companies than in that served by the other group ($874). Also, the ratio of taxpayers to customers is very nearly the same in each case (42.6 and 38.8 per cent respectively). In view of this noticeable divergence between the two parties who are most concerned about the *results* of public ownership, it is highly important for the municipal plants to avoid mulcting one class in order to benefit the other. An injudicious financial policy would mean that many who have received no direct services from their electric plant would be called on through the tax levy to bear the burden of losses for which they were in no way responsible.

From a study of the tax rates in the places in which the plants are situated, it is evident that the rates are about 8 per cent higher ($20.97 per $1,000 valuation) in the municipalities owning their plants than in those districts served by the companies ($19.42 per $1,000). The rate of increase since 1910, though not marked in either case, has been 40 per cent more rapid in the former than in the latter (10.4 as opposed to 7.4 per cent). Whether

this may be in some measure an artificial difference, due to the lower valuation of estates in those districts having public ownership, it would be difficult to state. It is obvious, however, that frequent calls are made on the taxpayers for funds to finance improvements and extensions, as well as to cancel old debts. The deficits which have existed from the beginning show clearly that the financial management of our municipal plants has been such as to impose added burdens on the tax levy. The total appropriations for construction, to date, amount to more than $820,000. And, in addition, there have been appropriations for bond, note, and sinking fund payments, which cannot by any means always be regarded as merely the payment for street lighting. These sums, compounded annually, would disclose the fact that the public has contributed to its experiment in ownership a far greater amount than at first is evident. The usual result of municipal industry which is not in all respects carried on as a commercial enterprise, and which can always call upon the taxpayers to make good any losses, no matter how incurred, is to make and keep the tax rates comparatively high.

But, while the foregoing analysis is suggestive it is far from conclusive, inasmuch as the five-year period covered is too brief to give sufficient background. In order to discover whether there is any vital connection between the valuation of estates, the tax rates, and municipal ownership, it is necessary to study the data from the beginning. Accordingly, in the accompanying tables are presented analyses of the material found in various reports of the State Tax Commissioner. Only the valuation of *real estate* is considered (which, of course, includes buildings and factory equipment as well as land), for it is of much more significance than the total valuation of all estates, since it will probably be more directly influenced by the general state of the public utility service in

TABLE 52. VALUATION OF REAL ESTATE AND TAX RATES IN MUNICIPALITIES IN WHICH GENERATING PLANTS ARE LOCATED

A	*Assessed valuation of real estate at certain periods in the districts in which plants are located—(to nearest $500,000—00,000 omitted)*						
	1890	1895	1900	1905	1910	1915	*Total increase (dollars)*
Companies.....	$76,0	$92,0	$110,0	$131,5	$154,0	$188,0	$112,0
Municipal plants[1].....	49,5	70,5	80,5	88,0	104,0	132,0	82,5
(Corrected for changed ownership).....	....	(71,0)	(82,0)	(91,0)	....	(135,0)	(85,5)
Holyoke.....	17,0	20,5	29,0	31,0	37,0	48,5	31,5
(Corrected).....	....	....	....	(32,0)	....	....	....

[1] Holyoke omitted.

B	*Increase of real estate valuation by percentages between certain periods—(to nearest 0.5 per cent)*							
	1890–1895	1895–1900	1900–1905	1905–1910	1910–1915	1890–1915	1895–1915	1895–1910
Companies.....	21.0	20.0	19.5	17.0	22.0	147.4	106.6	67.4
Municipal plants[1].....	42.5	14.0	9.0	18.0	27.0	166.6	87.2	47.2
(Corrected for changed ownership).....	(43.4)	(15.5)	(11.0)	....	....	(172.7)	(90.1)	(50.7)
Holyoke.....	20.5	41.5	6.9	19.4	31.1	185.3	67.2[2]	27.6[3]
(Corrected).....	....	....	(10.3)	....	....	....	....	....

[1] Holyoke omitted. [2] 1900–1915. [3] 1900–1910.

C	*Tax rate per $1000 assessed valuation of all estates at certain periods (arithmetical average)*						
	1890	1895	1900	1905	1910	1915	*Total increase*
Companies.....	$15.17	$16.58	$17.10	$18.38	$18.08	$19.42	$4.25
Municipalities.....	15.02	16.92	17.74	19.22	19.00	20.97	5.95

D	*Percentage increase of tax rates between certain dates*						
	1890–1895	1895–1900	1900–1905	1905–1910	1910–1915	1890–1915	1895–1915
Companies.....	9.4	3.1	7.5	−1.0	7.4	28.3	17.1
Municipalities.....	12.7	5.0	8.4	−1.0	10.4	40.0	23.8

E	*Tax rates in municipalities which acquired their plants between certain dates, together with percentage increase in rate during first five years' ownership*								
	Number	*Rate*		*Per cent increase*	*Rate in 1900*	*Per cent increase*	*Rate in 1905*	*Per cent increase*
		1890	1895					
Between 1890 and 1894.	6	$14.28	$18.15	27.0	....	....	....	....
Between 1895 and 1899.	6	....	16.90	....	$18.00	6.5	....	....
Between 1895 and 1899.	(5)	....	(16.80)	....	(18.50)	(10.0)	....	....
Between 1900 and 1904.	5	....	....	....	16.45	....	$17.98	9.3

a given locality and will be more sensitive to changes in business conditions. As statistics of this kind are liable to be misleading, the writer merely gives them for what they are worth, having made an honest attempt at a plausible interpretation. It is not altogether possible fully to verify the accuracy of the presumptions which may in certain instances be created.

From the figures given it appears that the valuation of property other than personal in the group of municipalities which later acquired their own generating plants, was increasing with great strides between 1890 and 1895, twice as rapidly in fact as the valuation of real estate in the other group. Now, while it is possible that the valuation in individual cases might be very arbitrary, this would probably not occur more frequently in one group than in the other, and the influence of this factor may be almost wholly discounted when we are interested in the total valuation of real estate in a group of seventeen places chosen more or less at random. Again, it is doubtless true that a good deal of the increase was occasioned by the installation of the private plants which were later taken over by the municipalities in question — an influence which, by the way, had in some measure spent its force in the other group, since their plants were built on the average a few years earlier. At any rate, there was a period of unusual growth in property values in these municipalities just preceding the time when they entered upon municipal ownership. The rate of increase would be even greater if a correction were made because of the fact that the plants acquired were not included in the tax levy of 1895.

Between 1893 and the end of 1895, however, eight municipalities began to do a commercial lighting business, and by the end of 1900 fourteen out of seventeen, excluding Holyoke, were operating their own plants. In view of this fact, it is, to put it mildly, very surprising to

find that the rate of increase in real estate valuation in these municipalities had dropped from more than 42 per cent in the preceding five-year period to only 14 per cent from 1895 to 1900. And in the next five years, after all of the group have undertaken the lighting business, there is a still more conspicuous drop in the rate of increase to 9 per cent. If corrections be made for the value of the plants taken over themselves, the rates are slightly increased to 15.5 and 11 per cent respectively. On the other hand, the group of municipalities served by the companies showed practically no variation in the rate of increase of real estate valuation throughout the entire period, while in the ten-year period, 1895 to 1905, their valuation had increased 43 per cent, as opposed to only 28 per cent in the other group after adjustments are made.

It is still more perplexing to find that the city of Holyoke, which purchased its plant in 1902 after some years of litigation, suffered a drop in rate of increase of real estate valuation from 41.5 per cent in the period from 1895 to 1900 to slightly more than 10 per cent in the succeeding five-year period, even after the correction is made for the change in ownership. It has been discovered that the valuations were abnormally increased during the first period, but even that fact seems scarcely sufficient to account for the marked decrease in rate from 1900 to 1905.[1] Though there are doubtless many other reasons for this decrease not known to the writer, yet the fact that the rate increased again to 19.4 per cent for the years 1905 to 1910, and the fact that there is a close correlation between the figures for Holyoke and for the group of municipalities owning their plants, makes it an open question whether the uncertainties regarding business which might naturally have resulted from the public

[1] A large amount of property belonging to the Holyoke Water Power Company, and formerly not taxed, was added to the taxable estates shortly before 1900.

ownership agitation, were partially responsible, at any rate, for the almost stationary state of real estate values during this period.

It might be argued in this connection that the municipalities, when acquiring their electric light plants, were also induced at about the same time to take over their water-supply systems, and that in this way the valuation of real estate for the time being was made comparatively less. Having looked carefully into this matter, however, the writer finds that the effect of any correction, with a view to eliminating this factor, works to the disadvantage of the group under public ownership and to the advantage of the group under private ownership. For, while the former, between 1890 and 1905 purchased or constructed waterworks to the total value of about $1,200,000, as indicated by the statement of municipal assets and liabilities returned to the State Tax Commissioner in the years 1890, 1895, 1900, and 1905, the latter took over in the same period systems valued at about $2,500,000, or about twice as great a valuation as in the first case.

Now, we would not be at all warranted in drawing any sweeping conclusions from the preceding figures. Too many qualifying conditions may, without our knowledge, enter into the problem. Yet, in view of the fact that the municipalities now owning their plants were at the earliest period growing far more rapidly than the other group which always retained private ownership, the data for the intervening years *may* indicate that many business enterprises were kept out or discouraged because of inadequate service or the lack of reasonable and customary inducements. It may also be that there was a general decrease in "progressiveness," due to the unbusinesslike policies which certainly characterized the earlier stages of public ownership of electric plants in this State, which might be expected to "react" upon the local business

men in such a way as to cause them to quit "boosting" for their municipalities. While private electric companies frequently, on their own initiative, endeavor to bring in new factories which will improve their power load, it is well known that, until recently at any rate, practically none of the public plants have followed this policy. Conversation with those in a position to know, including business men as well as the present managers of municipal lighting, has convinced the writer that there is much truth in the suggestions here made.[1]

Finally, the fact that the rate of increase in real estate valuations was by 1910 practically the same as that in the places served by the companies, and was somewhat more rapid between 1910 and 1915, may point in some measure to an encouragement of new industries and a general increase in business activity, as a result of the attempt to develop a power load on the part of the municipal plants, which had hitherto been lagging far behind. It must, however, be remembered that, as a group, the municipalities owning their plants are at present much more active manufacturing communities than are the others, for reasons which in a majority of cases probably have no direct dependence upon the local light and power business. Many large establishments have always used water power, and others have been forced to install electric plants of their own, because of the inadequacy of the facilities offered by the local plants.

Whatever may be the reasons, the disparity still remains between the two groups. If the period since 1895 be taken, as that date really marks the beginning of municipal electric lighting in Massachusetts, it is found that the total increase of real estate valuation in the places having public ownership has increased in twenty years about 90 per cent, after corrections are made, while the valuation of the corresponding group of municipalities

[1] Cf. ch. XII, pp. 340-341.

under private ownership has increased nearly 107 per cent, or approximately one fifth more rapidly. And during the critical period from 1895 to 1910 the increase in the latter was 30 per cent more rapid than in the former.

In the matter of tax rates it is interesting to note that the group of municipalities which later acquired their lighting plants actually had a slightly lower average rate in 1890 than had the other group. However, the rates began to rise for all concerned, and, as public ownership became more common, for every period the rate of increase was considerably greater in these places than in those served by the companies; while the total increase during the period here studied was more than 40 per cent greater in the former than in the latter. It must further be observed that if the municipalities now owning their plants be divided into groups according to the periods in which this business was undertaken, the rate of increase in the tax rates of these is markedly more rapid for the first five years of ownership than that of the remainder of the places not yet under public ownership or which have already for some time owned their plants.

The reasons for the fact just mentioned, and, indeed, for the more rapid increase in the average tax rate throughout the period, have already been partially suggested as caused by appropriations to meet operating deficits as well as some of the fixed charges. Yet this reasoning would apply more particularly to the earlier periods, when, as a matter of record, the increase was not so rapid as at present. During one of the five-year periods, however, from 1905 to 1910, there was in both groups actually a slight decrease in the rates. The entire problem is accordingly beset with a good deal of uncertainty. Nevertheless, we must remember that there are numerous indirect expenses which result when a municipality becomes an *entrepreneur*, but which it is rather hard to estimate. Public wants tend to be multiplied. Furthermore, there

is the possibility that a municipality, having gotten a good taste of public ownership of this kind, and having contracted a considerable debt in consequence, inclines to be somewhat more careless about the expenditure of money. To incur debts which later become very burdensome, may become habitual. The public purse-strings are often not held so tightly, and the tax rate must accordingly go up, particularly in cases where there is not an unusual increase in property valuations. Nor does the writer mean to dogmatize on this question of tax rates, for, as in the matter of valuations, there are too many unknown factors entering into the problem, many of which are dependent upon local conditions. Suffice it to

TABLE 53. FINANCIAL CONDITION OF MUNICIPALITIES IN WHICH GENERATING PLANTS ARE LOCATED, 1915

	Municipalities owning plants (excluding Holyoke)	*Municipalities served by companies*
Valuation of estates	$172,750,000	$269,800,000
Outstanding indebtedness	$9,556,000	$12,227,000
Electric plant debt	$1,508,825	...
Annual expenditures for maintenance, interest, and debt requirements (1914)[1]	$4,208,000	$5,795,000
Including expenses of electric light department	$4,824,000	...
Population	200,062	244,021
Per capita valuation	$864.	$1,106.
Per capita debt	$48.	$50.
Excluding lighting debt	$40.	...
Per capita expenses	$21.03	$23.75
Including lighting expenses	$24.12	...
Ratio of debt to valuation (per cent)	5.5	4.5
Excluding lighting debt	4.6	...
Ratio of expenses to valuation	2.4	2.1
Including lighting expenses	2.8	...

[1] The expenditures for 1914 are used because later data are not yet available. It is probable that the figures would be higher for 1915.

say that, whatever may be the correct explanation, the average tax rate in the group of cities and towns which own their lighting plants has markedly increased, and the rate of increase has been 40 per cent more rapid than in the other group under private ownership. Table 53, which the writer presents without comment, may be of interest to those who wish to theorize further on this subject.

B. Municipalities served by Purchasing Plants

It is scarcely necessary to go back of 1910 in our study of this aspect of the municipal ownership of purchasing plants, for the problems which they present are much different from those which characterize the group which has just been discussed. The prosperity of the territory of a plant which buys its current, other things being equal, probably depends more upon the source of supply than upon the plant itself.

It does appear, however, from Table 54 that the real estate valuations of the districts served by the municipal plants have been increasing much more rapidly than they have in the places occupied by the companies. While the rates of increase were in both cases comparatively close together between 1900 and 1910, the rate from 1910 to 1915 was almost twice as rapid for the former as for the latter. There is also, no doubt, a close correlation between the rapid appreciation in real estate values since 1910 and public ownership in these towns, for, if we include Wellesley, which began to operate its commercial lighting business early in 1907, nineteen out of twenty-one of them adopted municipal ownership between 1907 and 1914. Of these places, furthermore, only six were previously served by companies, and in some of these cases the service was far from satisfactory. Hence it is not to be wondered at that property

TABLE 54. VALUATION OF REAL ESTATE AND TAX RATES (PURCHASING PLANTS)

A	Valuation of real estate at certain dates in districts in which plants are located — (to nearest $500,000 — 00,000 omitted)					Percentage increase of real estate valuation between certain dates				
	1900	1905	1910	1915	Total increase	1900–1905	1905–1910	1910–1915	1900–1915	1905–1915
Companies[1] ...	$29.0	$32.5	$38.0	$44.0	$15.0	12.1	16.9	15.8	51.7	35.4
Municipalities[2]	27.0	30.5	30.5	47.0	20.0	13.0	19.7	28.0	74.0	54.4
Norwood....	3.6	4.3	8.4	11.5	7.9	19.4	95.3	37.0	219.4	200.0

[1] Franklin omitted — no return for Turner's Falls. [2] Norwood omitted.

B	Tax rate per $1000 assessed valuation of all estates at certain dates (arithmetical average)					Percentage increases of tax rates between certain dates				
	1900	1905	1910	1915	Total increase	1900–1905	1905–1910	1910–1915	1900–1915	1905–1915
Companies[1]....	$16.35	$16.45	$17.15	$17.65	$1.30	0.6	4.2	2.9	8.0	7.3
Municipalities..	14.48	15.13	15.00 (15.30)[2]	17.60 (17.63)	3.12	4.5	−1.0 (+1.0)[2]	17.3	21.5	16.4

[1] Franklin omitted — no return for Turner's Falls.
[2] Norwood omitted because of abnormal conditions.

increased greatly in value since 1910 as compared with the other group of towns which were supplied with electricity many years earlier, even though there may have been no particular increase in the number of industrial establishments and no noticeable heightening of business activity. And, finally, it is more than probable that many of these little towns are more progressive than those of the other group.

The case of Norwood, which apparently has had a 200 per cent increase in real estate values during the past ten years, is abnormal and somewhat misleading. During this period, or more precisely between 1905 and 1910, the town enjoyed a thorough house-cleaning, and among

other things an attempt was made to assess property at its true value, as a consequence of which policy there was an enormous artificial appreciation, which in turn led to an almost 50 per cent drop in the tax rate. There is, however, no denying that Norwood, due in large measure to unusually favorable circumstances, has made a very creditable showing with its plant and seems to have lost nothing in operation.

Finally, it is worth while to note that the average tax rate in these municipalities which have gradually acquired their plants, was much lower in 1900 than the average rate in the other group of towns, and there was practically no increase until after 1910. But, while the rate in the places served by the companies remained almost stationary between 1910 and 1915, the rate in the towns having municipal ownership — all of them having now acquired their plants — increased more than 17 per cent, or six times as rapidly as the average rate in the former. Though the tax rates in the two groups were in 1915 practically the same, yet during a period of ten years the increase in rates has been more than twice as rapid under public ownership as under private ownership, and *this* in spite of the much greater appreciation in value of estates.

Here, again, we must avoid drawing unwarranted conclusions from insufficient evidence; but the rapid increase in rates during the last period seems to have some significance when compared with the figures for the other group of public plants. Hence a few suggestions may not be amiss. Some of the possible or probable reasons for this state of affairs, though not so generally applicable in this connection, have been already referred to in the above discussion regarding the generating plants. It must further be observed that these little towns, having tried the experiment of municipal ownership, probably found it desirable to make numerous other civic betterments which had too long been neglected, just as a man who buys a

new suit finds that he must have a new hat, a tie, and a few more things to go with it. No doubt numerous improvements were made in the public highways, and possibly land was acquired or developed for parks — which could be lighted with municipal electricity. It is also true that a considerable number of them have installed water-supply systems within the past few years, which, because of local conditions, it has often been impossible to avoid operating at a loss.

TABLE 55. FINANCIAL CONDITION OF MUNICIPALITIES IN WHICH PURCHASING PLANTS ARE LOCATED, 1915

	Municipalities owning plants (excluding Norwood)	*Municipalities served by companies*
Valuation of estates	$69,748,000	$68,151,000
Outstanding indebtedness	$1,527,000	$879,000
Electric plant debt	$253,163	...
Annual expenditures for maintenance, interest and debt requirements (1914)[1]	$1,085,000	$1,041,000
Including expenses of electric light department	$1,264,138	...
Population	53,581	69,397
Per capita valuation	$1,300	$982
Per capita debt	$28.50	$12.70
Excluding lighting debt	$24.30	...
Per capita expenses	$20.25	$15.00
Including lighting expenses	$23.60	...
Ratio of debt to valuation (per cent)	2.2	1.3
Excluding lighting debt (per cent)	1.85	...
Ratio of annual expenses to valuation (per cent)	1.55	1.53
Including lighting expenses (per cent)	1.8	...

[1] The expenditures for 1914 are used because no later data are available. The figures would probably be somewhat higher for 1915.

But, while it is not altogether satisfactory to explain theoretically why the tax rates should have increased, and while this increase may only in a slight degree, so far as these towns are concerned, indicate that the plants

have been losing money, yet we are at least safe in drawing the conclusion that the incentives for "boosting" the rates under municipal ownership are unusually numerous and urgent. Though it is entirely too soon to form a fixed opinion on the subject, for reasons which have been suggested in various connections, the writer feels justified in predicting that the next five or ten years may witness an even more noticeable increase.

3. The Intangible Items

In 1897, a special investigating committee, appointed by the city of Holyoke to look into the subject of municipal electric lighting, reported that, under public ownership, there would result a saving of more than 25 per cent in the rates, and that after five years the city would own its plant, debt free.[1] Holyoke has done well, and the rates are low; but the outstanding liabilities, current and funded, together with the appropriations from the tax levy for debt payments, at present amount to about $1,200,000, though the plant still confines its operations to its own narrow territory, and probably a large investment in a new station will soon be needed.

Sixteen years later, another special committee, having made a careful investigation with the assistance of a trained engineer, reported to the selectmen of South Hadley that, if the town would take over the plant of the South Hadley Falls Electric Company, there would, in one year, be effected a saving to the municipality of $4,250, and the street lights, which had been costing $5,800, could thus be secured for $1,550. The plant *was* bought, — and under the first year of public management, the actual cost of the street lights, allowing for taxes lost, was between $6,500 and $7,000, or one sixth higher than when the service was supplied by private enterprise.

To be sure, such examples are merely suggestive rather

[1] Mass. G. & E., xiii: 44.

than convincing, yet there is no magic in the mere fact of public ownership which will enable service to be rendered at no cost to the public. If private business is already in the field, and if that business is properly regulated, there appears to be little reason for expecting that, in the economic sense, a gain will result from municipal operation of that service. On the other hand, there may be benefits of another sort, due to the enlivened interest which the people in general take in their public affairs. To quote from the aforementioned South Hadley Report, the committee, after investigating municipal ownership in the eight towns of the State,[1] made the following statement:

> Suffice it to say that all, without a single exception, were heartily in favor of municipal ownership, for both financial reasons and better service. . . . The matter of politics has not interfered in any case with the successful administration of the plant.[2]

They also received favorable reports from a number of other towns in the State.

Though the writer himself has not been able in person to investigate the actual conditions in all of the places mentioned, he is glad to believe that they are as stated, in these towns, as well as in most of the other municipalities in the State which own their distributing system and purchase their current. But a reverse picture is possible, and corrupt politics *may* be found instead of civic betterment. From what it has been possible to ascertain, the municipalities having their *generating* plants are not always so well satisfied. Some of them would gladly dispose of their plants. It has been in many instances a long, tiresome struggle, with the handicaps resulting from ignorant or hampered management and lack of foresight,

[1] Shrewsbury, Norwood, Wellesley, Groton, West Boylston, Ashburnham, Templeton, and Belmont. Cf. South Hadley Report, p. 3.

[2] South Hadley Report, p. 3.

in the course of which the careful supervision of the Board has prevented many serious mishaps. In addition to the service rendered by the Board directly through its audit of the municipal plant returns, and its advisory capacity, an expert engineer and accountant is employed to give assistance locally to those plants which are most in need. Thus they have managed to keep themselves going, and many of them appear to have done well.

Appearances, however, are frequently exceedingly deceptive. One cannot always discover the true conditions without being actually on the ground, and even then it may be almost impossible to find out what has happened in the past. In this connection it is worth while to give the following statement, secured by the writer before the local survey was attempted, from the very efficient manager of a municipal plant which had appeared for many years to be making an unusually good showing. As nearly as may be, the statement is here recorded just as the speaker made it:

When I became manager of the plant (about two years ago) the lines were in such a condition that they were positively dangerous, and in order to put them in proper shape again, it was necessary for months to employ four times as many linemen as had previously been employed. The voltage was inconstant — 50 or 60 when it should have been 110. Transformers were being overworked — in many cases a 5 kilowatt transformer was bearing a 15 kilowatt load. Many of the important customers' meters were found to be hopelessly incorrect. The circuits were not properly balanced; the power service was highly unsatisfactory. The returns made by this plant, as those of many other public plants, were hopelessly inaccurate, being for the most part mere guesswork in so far as the output of current is concerned, for the station meters had not been tested for years. There is no opportunity to look for new business, because the old cannot be properly cared for. All in all, the entire plant is so much out of date that it would require a doubling of the investment to put it in such a condition that it could properly serve the future needs of the community. Yet the public will not stand for the expense; they never seem to realize that the old equip-

ment must be replaced by new before it actually falls to pieces. I am trying to rectify the blunders of the past; but life as manager is simply "one damn thing after another." The trouble with this plant, as with most of the municipal plants in the State is that, both in the construction and the operation, no foresight has been exercised. Taking the public plants as a whole "I would not give them much."

Now, the reader might contend that the above statement is little more or less than a bad case of "sour grapes." This, however, is not true. The information was secured under conditions which left no doubt as to the veracity of the witness, and, furthermore, the writer, upon visiting the plant several months later, found conditions even then far worse than he had been led to expect. He also knows that the condition now is critical, and that there have been some active negotiations with a view to selling the plant to private interests, which, by the way, will probably never amount to anything, as a result of the legislation passed not long ago to the effect that a municipality wishing to dispose of its plant must go through the same tedious process by which it acquired that plant.[1] Needless to say, local pride will probably keep the majority of the people of a community from admitting at the polls that they have made a failure, and there will always be many who fear that to sell their plants, even though they may have developed into white elephants, would be to "sell out" the "public" to the "interests."

Without further multiplication of examples, the writer can state that the foregoing is by no means an overdrawn picture of many of the conditions which are about to be discussed in the following chapters. It is also true that, though conditions appear *at present* to be somewhat improved, the ignorance and inefficiency which have in numerous instances characterized municipal management, often due to the fact that so many people feel it

[1] Mass., 1917, ch. 205, sect. 1.

incumbent on them to take a hand, have frequently been *in the past* astounding. Here, as in Wisconsin,[1] the most arduous task of the Commissioners has been that of impressing upon the municipalities the need of applying to their business, in part at any rate, the same tests by which the efficiency of private business is measured. Yet, after a quarter of a century of regulation, the lesson does not seem to have been wholly learned. Reams of correspondence regarding the simplest problems of accounting, are from year to year passed between the clerk of the Board and the various public plants. As fast as managers change, many lessons must be taught afresh. The wonder is that, under the circumstances, municipal ownership has done so well. Whatever may have been the shortcomings of commission regulation in this State, the degree of success attained by these plants has been due in large measure to the Board, rather than to their own unaided efforts. Here, for the present, let us leave this aspect of our study, reserving any criticisms or suggestions until the results of the local survey have been set forth.[2]

Summary

1. The returns are highly unsatisfactory so far as the labor and wage data are concerned.

2. There has been a more rapid rate of increase in the number of workers employed by the generating companies, due, perhaps, to their more extensive distributing system.

3. The labor efficiency of the companies, in both groups, is greater than in the municipal plants. That of the pub-

[1] Holmes: 281.

[2] The writer's recent work on the Federal Census of Central Electric Light and Power Stations has enabled him to discover how far superior the records and business methods of the Massachusetts municipal plants are to those of most other states. In the majority of cases they do not seem to have the least inkling of how their accounts should he kept, and they rarely know whether they are actually making or losing money.

lic generating plants, however, is increasing rapidly, while there is really not much choice between the purchasing plants.

4. So far as can be ascertained from the returns there is little difference between the average wages paid by each group.

5. The municipalities owning their plants have been noticeably slower in adopting the recent progressive labor legislation than have the municipalities served by the companies.

6. The tax rates of the municipalities owning their plants have increased more rapidly in both groups than have the rates in those places served by the privately owned plants. The average tax rate is at present considerably higher in those municipalities where the public generating plants are found than in the other group. For the purchasing plants, however, the rates are almost identical.

7. Though formerly the real estate valuations increased much more rapidly in the districts served by the generating companies, at present the rate of increase seems to be about the same for the two groups. In the municipalities owning only a distributing system, the rate of increase in valuations has, on the contrary, been much more rapid than in the places securing service from the corresponding group of private plants.

8. While the municipalities owning their distributing systems only, seem in most cases to be well content, there is or has been evidence of considerable dissatisfaction in many of the places which own their generating plants. The returns do not always represent the *true* conditions.

9. The passing degree of success which has been attained by some of the municipal plants, has frequently been due largely to the fostering care of the Board of Gas and Electric Light Commissioners rather than to any superior efficiency of their own.

CHAPTER X

THE LOCAL SURVEY

THOUGH the preceding careful analyses of all available statistical material have clearly pointed the way to rather definite conclusions upon the subject of municipal ownership, yet the reader might still reasonably entertain doubts regarding the accuracy of this investigation, provided the writer had not made a first-hand examination of the local conditions and the operating policy of a representative number of the plants studied. Many doubtful questions can be readily solved when one is actually on the ground. Much additional information of great value can thus be secured. And, finally, a personal knowledge of the individual cases lends interest and life to a study which might otherwise prove somewhat dull and academic to the average reader. Accordingly, the writer will in the present chapter outline the manner in which he personally conducted an extensive local survey of the groups of plants under consideration, after having completed his analyses of the annual returns made to the Board of Gas and Electric Light Commissioners.

Before launching into the details of this portion of our subject, it may be well to explain with some care the methods of investigation which were followed. In the first place, the writer, assisted by expert and wholly disinterested engineers and accountants, studied with great care the operation and the managerial policies of some typical central stations in the State which are not included in the list of plants herein discussed. Thus it was possible not only to become more familiar with the actual conduct of the electric light and power business,

but also to establish certain impartial standards which might safely be used in passing judgment upon those plants which were later to be visited.

Then a composite schedule of questions was prepared, covering many points of necessity overlooked in the annual returns, though highly significant for one who is attempting to pass upon the comparative merits of public and private ownership. Needless to state, this schedule was meant merely to serve as a rough sort of guide in making the survey. It was neither inclusive nor exclusive, and often not altogether logical, but was at any rate suggestive. Some of the questions admitted of no definite answer, while others were significant only to the extent that they might throw light upon certain obscure aspects of the problem, or furnish clues to further investigation. The topics were not treated in the schedule in the order in which they have been developed in the preceding chapters. In fact, this order was in some cases practically reversed, as it seemed easier in that way to secure the information desired. The later and more detailed questions frequently served as a check upon the more general questions appearing earlier. Perhaps it will be of some interest here to reproduce this list, which was substantially as follows:

SCHEDULE FOR MUNICIPAL AND PRIVATE ELECTRIC LIGHT PLANTS

Name of Plant

(*Answer those questions which apply*)

A. General

1. Why did municipality acquire plant?
2. What is the attitude of the citizens in general toward this form of management?
3. What is the attitude of business men?
4. What is the attitude of the municipal government?
5. Is there friction with other municipal departments? (Indicate clearly.)

6. Have politics played any part? If so, indicate definitely. (Also see later questions.)
7. Is there competition of gas or of other electric plants? If so, what relations exist between the two?
8. Is any effort made to secure new business? If so, what methods are followed?
9. Have industries been kept away because of lack of adequate electric facilities?
10. What proportion of the local industries is supplied with power?
11. Has the future development of business been adequately provided for?
12. What are the objections, if any, to the present system, and what needed changes can be suggested?
13. Is there any desire to change to private (public) ownership? Why?
14. Is municipal (or private) ownership in —— a real success? Why or why not?

Remarks:

B. Management

(*These questions apply largely to municipal plants*)

1. Is the Municipal Light Board bi-partisan?
2. Have the members of the board a technical knowledge of the business?
3. By whom is the manager appointed?
   (*a*) For how long a term?
   (*b*) How long has present manager served?
   (*c*) What is the basis of selection?
4. How much authority is given the manager?
5. Has his authority been wisely used?
6. Who purchases materials?
7. How are contracts let?
8. Are local dealers favored?
9. Is it difficult to obtain supplies because of slowness of appropriations?
10. Is the manager ever offered a discount by dealers, in the form of a "rake-off"?
11. Is the manager a technical graduate? If not, what is his general education and his *special* preparation for this work?

12. Is he a member of any technical society? If so, give name. Does he attend meetings of any scientific societies?
13. Does the manager give all of his time to the work? If not, how much?
14. Has the manager ever played politics?
15. Has he ever been interfered with for political reasons?
16. Is his salary deemed adequate? State salary. Does he receive any perquisites besides his salary?
17. Has there been dishonesty or incompetence in the past?

Remarks:

C. Labor

1. How is the average number of employees returned to the Commissioners computed? Give number.
2. How are the employees chosen?
3. Have political considerations governed appointments of employees?
4. Have employees taken any undesirable part in politics?
5. How many of the employees are technically trained?
6. How many belong to technical societies?
7. What are the hours of labor?
8. What are the customary wages for the different classes of labor (salaried employees included)?
9. What rate is paid for overtime?
10. Do the employees give all of their time to the electrical business?
11. Is the service of employees of other municipal departments utilized? If so, to what extent?
12. Is any system of promotion followed?
13. Is there any definite attempt to measure the comparative efficiency of employees?
14. How long, on the average, are the different employees retained?
15. Who has the power of discharge?
    (*a*) Is there an appeal from this decision?
    (*b*) What are the usual grounds for discharge?
16. Are foreigners employed? What nationality?
17. What vacations or holidays are allowed with pay?
18. What is the extent of the sick leave granted (with pay), if any?
19. Is there any welfare work?

20. Do employees receive any free service or gratuities?
21. Are they unionized?
22. Have there been any strikes or less serious labor troubles?
23. Do the employees seem to be satisfied with their wages and conditions of employment?
24. Are the relations between employees and employers altogether pleasant?
25. Are they courteous in their dealings with the public?

Remarks:

D. Central Station

1. What is the condition of the boilers?
2. What are the facilities for handling coal?
3. What is the condition of engines?
4. What is the condition of generators, and the *actual* capacity?
5. Are there any storage batteries?
6. How often are the station meters tested?
7. How is the maximum demand measured?
8. In general, is the equipment up-to-date? Criticisms.
9. What recent additions or improvements have been made?
10. What additions or improvements are under way or contemplated?
11. Is there a storeroom? If so, in what condition is it kept?
12. Is the "housekeeping" of the plant good?
13. Is the ventilation adequate and are safety appliances provided?
14. Is the station sufficiently roomy?
15. Is the plant adequate for the present as well as for the immediate future? (Indicate clearly.)
16. Does it seem desirable to continue the generation of current? If not, why?
17. Why did the plant cease to produce its own current?
18. Is the electric plant operated in connection with a water-supply system or a sewage disposal plant?
19. Is the location of the central station satisfactory from an engineering and an economic point of view?
20. Are there any experiments being carried on?
21. Is there adequate office-room?

Remarks:

E. Distribution

1. Is the town level?
2. Are the streets straight?
3. Is there much foliage?
4. Was blasting necessary in setting poles?
5. Is there an underground system? (Give length.) If so, what policy governs its installation?
6. Are the lines extended according to the demand? If not, what policy governs the extension?
7. Are extensions promptly made? Has favoritism ever been shown?
8. Do the customers ever bear a part of the cost of extension? Frequently? If so, how is the cost apportioned?
9. When a customer pays part of the cost are the construction accounts written up proportionately, or is this item not recorded?
10. What proportion of the poles are owned? (Give numbers.)
11. Is pole rental paid? If so, how is the charge carried?
12. What seems to be the average life of the poles? Of lines?
13. How is the length of lines and of streets with overhead lines determined?
14. Is there a complete map of the distributing system?
15. How is the connected load determined? (Distinguish as to light and power load.)
16. What percentage of current is used at station and unaccounted for?
17. What reason can be given for this high percentage (if total is over 25 per cent)?
18. In general, what is the condition of the distributing system?
19. How frequently are the lines inspected?
20. Is a careful account kept of distribution tools?
21. Is the contract or "job" system used in making extensions, or is the direct employment method followed?
22. Was the original line construction satisfactory?
23. What proportion of territory and of population is served?
24. Are small customers avoided?

Remarks:

F. Consumption

1. Are customers' meters regularly tested?
2. Are customers' complaints promptly attended to?
3. How are complaints handled?
4. Is inside work done by the company (municipality)?
5. Are appliances sold? Fixtures? On what terms?
6. Are special rates made to large customers? On what basis?
7. Is there general satisfaction (*a*) with the rates? (*b*) with quality of service?
8. How often are street lamps patrolled?
9. How often are accounts collected?
10. Are customers' deposits required?
11. Does the Department collect accounts?
12. Who does billing?
13. Have rates been reduced without an appeal to the Commissioners?
14. Enclose rate schedule.

Remarks:

G. Financial and Miscellaneous

(Questions 1 to 20 apply in the main to municipal plants only)

1. Are the accounts audited?
   (*a*) How often?
   (*b*) Who does the work?
   (*c*) Who bears the charge?
2. Is service rendered to other municipal departments without compensation?
3. Is service secured from other departments without compensation?
4. Is payment made (in case of municipal plants) for street lighting? For lighting public buildings? For municipal power?
5. Are these actual payments or merely nominal?
6. Is city water paid for at the usual rates?
7. Is telephone and transportation service fully paid for?
8. Is any portion of salary of town treasurer or of the solicitor paid for (if services of latter are used)?

9. Are any quarters used rent free?
10. Is any land not carried on the books of the plant used rent free?
11. Is the police and fire alarm service furnished free?
12. Is there any other free service?
13. Estimate, by items, the value of the free service given and received.
14. What different kinds of insurance are carried? Who pays the premiums?
15. How is depreciation provided for?
16. Is the depreciation fund a *real* fund? (Municipal plants.)
17. Are the construction accounts considered accurate?
18. Has the construction or maintenance of plant been financed to any extent by gifts or public contributions?
19. If so, is any record of such sums kept on the books?
20. If the plant is operated in connection with a waterworks system or a sewage disposal plant, how are the operating expenses and the investment apportioned.
21. What is the approximate investment in equipment not in use? (Refers particularly to plants which have ceased generating.)
22. Has there been waste or extravagance in investment? In operation? (Indicate clearly.)
23. Has the financial policy been over-conservative?
24. Is a clear distinction made between ordinary repairs or maintenance, renewals, and additions?
25. Has the normal amount of new construction been installed during the year 1916–17?
26. What is the length of contract for municipal lighting? What are the terms?
27. How much is expended for advertising and getting new business?
28. What check is there on financial dishonesty?
29. Criticism of accounts.
30. Enclose latest annual report of the department (municipal plants).

Remarks:

SIGNATURE

The next step was to prepare the way for the personal visit. This was done in the case of the municipal plants by means of letters to the manager and to the chairman of selectmen or the mayor, and sometimes to the chairman of the municipal light board. In dealing with the private plants it was necessary to follow different methods, depending upon the nature of the ownership in each case. For the plants independently owned and operated, letters were sent to the managers or superintendents and to one of the active officials of the company. When, however, the plants were controlled by groups of investors, it became necessary first to get in touch with the recognized officials of these groups or with their general managers, and through them to take up the matter with the local managers or superintendents. In addition, letters were also sent to the chief municipal officials as in the case of the publicly owned plants.

The following is a sample of the usual form of letter used, which was varied in details to suit the different cases:

DEAR SIR:

As a member of the Department of Economics of Harvard University, I have been making a detailed study of municipally owned electric light and power plants in the State of Massachusetts. In order to make this study more conclusive I have selected a number of private plants which, chiefly by reason of their size, may fairly be used for purposes of comparison. The local plant happens to be on my list.

My work has until recently been confined largely to an examination and interpretation of the annual returns submitted to the Board of Gas and Electric Light Commissioners. With a view to testing my conclusions, however, I find it highly desirable to make a personal survey of the plants and districts which I have been studying. I hope to come to ——, in a short time, and trust that you will give me an opportunity to discuss with you the local situation, and to visit your plant, etc.

It may be well to state in this connection that I represent no special interests in this matter, and am wholly free from prejudice either for or against municipal ownership. As a student of public

affairs I simply wish to find out as nearly as possible the actual conditions, in so far as they have a bearing upon the general problem. All information of a private nature will be treated as strictly confidential, and, should I eventually decide to publish the results of this study, the condition of individual plants will not be disclosed.

Hoping to have the pleasure of meeting you soon,

Yours very truly

After these preliminaries there remained simply the task of getting in touch with the local parties. When it did not seem necessary to visit a purchasing plant because of its smallness, or when it was impossible to do so, a schedule was enclosed to be filled out by the different parties in so far as it might be applicable and so far as their knowledge of the situation might go. In the case of the centrally controlled companies schedules were also filled out at the general office.

It must not be inferred, however, that the writer merely visited these plants and discussed the general situation with the officials and with the municipal authorities. In addition, whenever there seemed to be any reasonable chance for error, or when the facts were still in doubt, and sometimes mainly with a view to satisfying a pardonable curiosity regarding diverse opinions, other parties were consulted, including the employees, business men, representative citizens, officials of competing gas companies, and central station men in adjoining territories. Finally, it was often instructive to discuss such matters with officials of neighboring municipalities and with public utility men who had business interests in the various localities.

The information thus secured through different channels, properly analyzed, duly tested according to the source of the evidence, and interpreted in the light of the already known data, in the most important particulars affords highly significant and really dependable confirma-

tion of the tentative conclusions which had previously been reached by the writer.

All of the eighteen municipal plants which were in 1915 generating some current were visited, together with ten of the more important generating companies. For four other companies of this group carefully filled schedules were secured, either locally or from the central office. Thus definite and dependable information was obtained regarding thirty-two of the thirty-five generating plants studied.

Though it did not seem necessary to make so careful a survey of those plants which are merely distributing their current, yet the writer visited five or six of the larger municipal plants, and has secured schedules or other definite information from the majority of those remaining. In most cases also the local situation was carefully discussed with men who had been on the ground, so that there seems to be little opportunity for error in drawing conclusions. Beyond a doubt, however, it was more difficult to obtain the desired data regarding these little plants than in the case of the corresponding group of companies. Of the latter, two of the larger were visited, and the territory served by several of the others was passed through, while schedules and other satisfactory information were secured for fifteen out of the sixteen plants in this group.

In this connection it is but just for the writer to state that he was highly gratified by the candor and consideration with which he was received by all while making this survey. Each municipal lighting manager was uniformly courteous, giving generously of his time whenever it was asked for, placing absolute confidence in the integrity of the writer, and frequently revealing facts regarding the conduct of his plant, which, though most useful to the investigator, might have proved somewhat disastrous if divulged.

As the present study has to do primarily, not with public utilities in general, but merely with those which are municipally owned, it was to be expected that the companies would exercise some degree of caution before giving a warm welcome to an investigator who was not at the time connected with any business enterprise. It must also be remembered that the first duty of the officials of a corporation is to guard well the interests of its owners — the stockholders. And, finally, no individual connected with a privately owned plant occupies the unique position of almost absolute authority enjoyed by the manager of a municipal plant; hence, it would naturally be more difficult to get in touch with the inner conditions of the former, particularly during the present unsettled times. Yet the greatest consideration was constantly manifested by officials of the various companies, who afforded the writer every facility, permitting him not only to inspect their plants, but also their records if he so desired. In only one instance was he refused admission to a generating plant, and that refusal was due to a misunderstanding rather than to any active antagonism.

Upon the whole, the writer was delightfully surprised at the unusual interest displayed in this survey when its purpose was explained. Particular mention should also be made of the management of the numerous centrally controlled companies, who almost invariably showed a more intelligent and helpful appreciation of the present work and its difficulties than was manifested by some of the officials of locally owned companies. The general spirit which prevailed may best be indicated by the three letters following, one from the mayor of a city, the second from the manager of a municipal plant, and the last one from the president of a number of companies:

July 20, 1917

DEAR SIR:

Your communication of —— is at hand. We are always glad to discuss our municipal plant with anybody. The Manager will extend to you every courtesy on your visit here, and I shall be glad to have you call upon me.

Very truly yours

Mayor

July 24, 1917

DEAR SIR:

Yours of —— is at hand. I desire to say in reply thereto that it will give me a great deal of pleasure to have you examine our plants at any time that is convenient for you, and to give you any information that you may desire. . . . If you will kindly advise a day or two in advance of your coming, I will arrange to meet you and spend as much of the day with you as you may require.

Yours very truly

Manager

August 2, 1917

MY DEAR SIR:

I have your letter of —— in regard to the investigation which you are making of municipally owned electric light plants in the state. We shall be very glad to have you inspect the property of the —— Company, and we are ready to place at your disposal all the records of the company and such books and accounts as you care to consult.

The subject of municipal ownership is one in which every manager of a privately owned company should be keenly interested. I shall be very grateful to you for any light which you may be able to throw upon the subject, and shall be glad to coöperate with you in every way to make your investigation as searching as possible. If, when your investigation is completed, the results of it are to be published, I should like to have a copy.

Yours very truly

President

CHAPTER XI

THE LOCAL BACKGROUND: GENERATING PLANTS

FROM time to time, whenever it served to clear up obscure or doubtful points and usually whenever it was relavant, reference has been made in the preceding chapters to certain portions of the information secured in the local survey. This part of the work, however, was done last in point of time, as logically it should be, and we are here primarily concerned with a less readily measurable kind of material than that which has been handled in the earlier stages. Hence, not only does clearness of presentation demand that these different data be kept separate, but also the writer feels that by so doing he can put his case more strongly and can best appeal to the sense of fairness of his readers.

The writer was in no way influenced by his previous findings during this aspect of the investigation. On the contrary, he merely made use, when necessary, of certain undoubted facts with which he was already familiar, forgetting for the time being any tentative conclusions which he might have reached. And now, when all of these additional data are assembled, they can be the more readily interpreted because of the previous studies, and, inasmuch as they point to similar conclusions, the reader can rest assured that he has not been led astray by the statistical analyses. Needless to state, it will not be necessary to discuss all of the questions appearing upon the schedule, as many of them overlap and some are of slight importance when considered alone. Also, to avoid confusion, an effort will be made to adhere to the order of treatment followed in the earlier chapters rather than to the arrangement given in the schedule. As all information was im-

parted in confidence, the names of individual plants will not be disclosed in this connection. The plants generating current in 1915 will accordingly be discussed first.

1. The Central Station

It is rather difficult to make brief comparisons of the central stations and their equipment which will not prove misleading. What is suitable in one place may not be suitable in another. Circumstances frequently alter cases. Accordingly, depending as much as possible upon the statements of local officials rather than attempting to set up any arbitrary standards of his own, the writer has endeavored to pass upon each case as nearly as may be separately and to consider it in relation to the local conditions. In the case of plants which have ceased to generate current, the equipment will be discussed as it was in 1915, provided it has not already been removed.

In general it appeared that the boiler rooms of the companies were kept in better order and the steam pipes in a more satisfactory state of repair. They also in many cases provided more convenient facilities for receiving and handling coal, though but a few plants in either group were equipped with automatic stokers. The companies further had more adequate boiler capacity, whereas a very frequent complaint of the public plants was that they had reached their limit and that service would have to be suspended if any accident should occur. The employees of the latter also reported many boiler troubles, and the chimneys were frequently too small to give adequate draft. CO_2 recorders and economizers were for both groups usually conspicuous by reason of their absence.

The earlier statement to the effect that the units of the municipal plants are noticeably older than those of the companies was very evident upon examination. It was also discovered that this difference, particularly in so far as the engines and dynamos are concerned, is frequently

much greater even than the returns would seem to indicate, for in many instances they have installed second-hand apparatus — a fact which is naturally not disclosed in the records. The most extreme case of this sort which came to the notice of the writer was one in which an engine that had been scrapped by an adjoining company about fifteen years earlier, was recently installed in a municipal plant, having been purchased practically at its junk value. Thus the capital account was kept down and a good investment showing made for the year.

An obvious advantage seemed to lie with the companies in the matter of generating equipment, which, in all cases except one (out of fourteen), might be rated as "excellent," "good," or "fair," whereas for the municipal plants at least eight would have to be referred to as "poor" or "very old." In justice, however, it must be stated that some of the latter had purposely refrained from renewing or replacing their equipment because they were merely waiting for a good opportunity to purchase current. On the other hand, several have undoubtedly been forced to stop generating because their equipment had become so run down and antiquated that an entire new investment would have been necessary. Of this more mention will be made shortly. As to whether the stations in general are "up-to-date," the answer would be "yes" or "fair" for most of the companies and decidedly "*no*" for at least half of the other group. One of the municipal plants is operating single-phase and three or four still use the two-phase system.

Regarding the testing of station meters, it was found that while practically all of the companies had regular tests at intervals varying from three months to one year, half of the public plants reported "indefinite" or "when needed," and one frankly stated "never." One of the latter, and until recently one of the former, has no means whatever of determining the station output. As the chief

engineer says, they make their current "by guess and by God." It was also noticeable, and to be expected, that those municipalities which are purchasing their current from private concerns, are considerably more careful in this matter than they were while producing their own current. Practically none of the municipal plants and comparatively few of the others were equipped with maximum demand indicators, and many of the switchboards of the former were antiquated, inconveniently placed, and even dangerous.

A good many improvements had been made by both groups since 1915, a number of new turbines having been installed, while one of the companies has constructed a magnificent new station, which, of its size, is undoubtedly the best in the State.

While it is difficult to make comparisons of what may be termed the "housekeeping" of the plants, due in some measure to the fact that considerations of space may affect the situation, yet the writer ended his investigation with a distinct impression that in general the conditions were appreciably better in the companies, in several of which the only proper designation would be "excellent."

There was little to criticize as to the ventilation of the private stations, but at least half of the other group must be said to have "poor," or at most only "fair" ventilation. While it might be expected that the State inspectors would see to it that adequate provisions are made for the safety of employees, yet the writer was somewhat surprised to find that in many of the municipal plants the switchboards are unprotected, and in some cases crowded so close to the wall that there is scarcely room for the operator to pass. Much of the apparatus in the older and more crowded plants of this group is a constant source of danger to the employees.

The companies almost without exception have roomy stations and plenty of office space. Of the municipal

plants, however, several stations are so small and congested that conditions are highly unpleasant for the employees, nor are they large enough to permit the installation of much needed equipment. There is absurdly insufficient office room in six or seven of the latter, and in several cases the office is located at the station itself in a place highly inconvenient for the public.

So far as the location of the central station is concerned, it is "unsatisfactory" or "doubtful" in three of the ten companies visited, while for the other group it is obviously "unsatisfactory" in at least five cases and "doubtful" in several more. This state of affairs is in some measure accounted for by the fact that most of the five municipalities operating their water system in connection with their lighting plants, had, for the sake of economy in investment, installed the latter in the premises occupied by the former, with no thought of the inconveniences, difficulties, or increased operating expenses which might thereby be involved.

The answers to the question regarding the adequacy of plant for the present and the immediate future, furnish a highly significant commentary upon some of the problems of public ownership. Taking both groups as they were in 1915, it appears that at least three of the companies were inadequate and as many more in a doubtful condition. But of the municipal plants at least ten were obviously inadequate, whether because of antiquated equipment or by reason of insufficient capacity, while three or four others occupied a doubtful position.

Hence it is not strange to find that some two years later three private plants and seven public plants have ceased to generate their current — though some of them are keeping their equipment in condition to use in case of emergencies. Two other municipal plants are at present seriously considering the same step, while two addi-

tional ones which were on the point of buying all of their current, have, in the one case because of a false local pride, and in the other because of unbusinesslike methods followed in attempting to negotiate a contract for the purchase of current, been compelled to continue the business of generation. Of the remaining plants of each group only five or six in either case assert definitely that it is desirable to continue to produce current, the reason given in some instances being that they are not at present within reach of a selling company. The recent rapid development of hydro-electric plants has, however, marked the end of profitable steam generation by any but the largest plants.

Of the companies ceasing to make their current, one obviously did so because of the great investment which would have been necessary to put the plant in proper shape, another because of the high cost of coal, and the third largely because its owners were also interested in some water-power development which they wished to utilize. Four or five of the other group ceased generating for the most part because of the greatly increased investment which would have been necessary to enable them to give satisfactory service, while the others seem to have been influenced most by the high cost of fuel. All of the companies and three of the municipalities are buying current generated by water power.

Four or five of the remaining municipal plants will before long be forced to double their investment in order to give the service which the people are demanding and have a right to expect. In fact the largest plant of this group in the State is seriously considering the advisability of installing a thoroughly new station at a cost of probably more than $2,000,000. The development of the territory is such that this step will soon be necessary unless current is to be purchased from one of the hydro-electric companies; for the original station, taken over

from a private concern, is from nearly every point of view at present highly unsatisfactory.

That so many public plants are scrapping their station equipment is by no means a sufficient reason for condemning the proposition of municipal ownership in general. Rather, the management is probably displaying excellent judgment in ceasing to do what can be more cheaply done by private enterprise. Whether under public or under private ownership, the day of the small generating plant is passed. But the rather unpleasant fact remains, that the progress of the art, making possible the satisfactory transmission of current over long distances, has brought it about that the municipal plants of Massachusetts will be burdened with hundreds of thousands of dollars of investment in dead assets, upon which they will in most cases continue to pay interest for many years. This investment, together with the interest paid thereon, should be compounded regularly, divided by the number of years during which a given plant was operated, and then apportioned to the annual amount of current used for street lighting, — or also added to the commercial rates, if they were lower than those which would have been charged by a private plant, — provided one really wishes to know something about the cost of service under municipal ownership. The "long run" must always be considered when large issues are studied.

2. Distribution

While an attempt was made to select plants which are operating as nearly as may be under topographically similar conditions, yet it was found upon actual visitation that in a large number of cases the companies are located in places where the surface is hilly, the streets irregular, the soil rocky, and the foliage unusually abundant, whereas the conditions existing in the other group were generally decidedly more favorable. The rocky or excessively

irregular condition of the ground makes the installation of poles a more expensive undertaking, and with a greater amount of foliage the cost of upkeep of lines is much increased as well as the difficulty of lighting the streets. In these regards, accordingly, the public plants would seem to have a considerable advantage. (The reader will also recall that, as shown in an earlier chapter, the companies are serving a much more scattered population than are the municipal plants, and that they are reaching for the most part a greater proportion of the inhabitants.)

In dealing with the distributing system it was a difficult matter to discover how many poles are owned outright and how many are jointly owned or merely used for attachments, for not until the present year did the annual returns made to the State Board definitely require such information. However, as it has been suggested in the chapter on physical statistics, the companies appear to own a much larger proportion than do the municipal plants. Joint ownership is common to both groups, and some rentals are paid by both — more frequently by the companies. There are other arrangements of joint or complete maintenance, and sometimes municipalities seem to regard and use as public property any poles which have been placed in the streets by private concerns. Upon the whole the public plants have a decided advantage over private plants in this matter, for under the police powers of municipal corporations they can do what they please with the poles for which a location has been granted, or, on the other hand, the authorities may refuse to grant locations until they have secured the concessions which they may wish. In general the managers of municipal plants seem to endeavor to keep on good terms with the other public utilities in this matter, but the fact still remains that they desire to avoid expense under this head. It is unnecessary to weary the reader further with the details of the various forms of agreement which are entered

into, except to say that nearly every plant handles the problem in a different way.[1]

Only three of the municipal plants state that they feel practically certain of the length of their lines, having actually measured them. Four others report that they have merely scaled the "streets with overhead" from blueprints of the city engineer, without attempting anything further; while the remainder simply indicate that the "length of street lines" returned is built up upon the earlier estimates and records, and that it is beyond a doubt no more than a rough approximation. Practically all of the companies report that the length of their lines is determined by actual measurement. Only eight of the eighteen municipal plants appear to have more or less satisfactory maps of their distributing systems, but almost all of the private plants seem to be reasonably well equipped in this regard.

As to the condition of the distributing system in general, it appeared to be for the most part "good," though in a few cases only "reasonably satisfactory," for all of the companies from which information was secured. Several of the municipal plants have line construction much below the standard both in the size and quality of poles and in the size of wire, while the condition of the rest is about equally divided between "good" and "fair." In five or six of this group the original construction was

[1] Naturally many of the agreements are so vague that much confusion might result. Among other amusing instances occurring in this connection, the writer was told of a case in which the town was supposed to own the alternate poles, the rest belonging to the street railway company. On one occasion a valuable horse ran away and killed himself by bumping into one of the poles which was not properly located on the street. The owner sued the town for damages. Then the question arose as to whose pole it really was that killed the animal. The company began to count in one place and maintained that the town owned the guilty pole; the town began its count elsewhere, and accused the company's pole. Finally, after much litigation, the matter was compromised by each party paying half of the damages.

clearly unsatisfactory; but, so far as could be ascertained there had been no particular complaint about this point in the case of the companies. In the matter of line inspection, according to the statement of officials, there seems to be little to choose between the two groups, except that four public plants report no definite or regular inspection. The others for the most part report "constant" inspection, and in some instances "monthly," "semi-yearly," "yearly," or "after storms."

The connected lighting load in both cases seemed to be more or less roughly estimated, though some take the trouble to make frequent house inspections in order to determine the customer's maximum demand. The companies apparently exercised the greater care in keeping track of their power load.

There seems to have been some reduction in the amount of "current unaccounted for" since 1915, though in several of the municipal plants it was still very high. Part of the difference between the two groups can be accounted for by the use of too small wire, tree contacts, old meters and transformers, and small transformers. (As stated in an earlier chapter, the transformers of the companies average about 8 per cent larger than those of the municipal plants.) It was also significant to learn that some of the companies which of necessity used numerous small transformers because of their large lighting business occasioned by summer customers, follow the practice of "cutting out" these transformers during the winter months when they are not needed, thus preventing a very considerable loss of current.[1]

Furthermore, the irregularity with which the station meters of the municipal plants are tested may account for part of the apparent loss. Also, in two rather important cases the writer was surprised to be told on good authority that there had been an actual "rigging" of the

[1] For a fuller discussion of this subject, see ch. IV, pp. 100–104.

transformers and meters in several instances, so that the customer was billed a much smaller amount of current than he had actually consumed. Finally, it is worthy of note that the public plants which have begun to buy their current have greatly reduced their "unaccounted for." When there is a direct outlay for every kilowatt hour used, some incentive is given to stop the more common sources of loss.

For the most part the direct method of employment was followed by both groups in making extensions. The policy adopted in extending lines varies more or less according to the character of the district served. Yet six or seven public plants state that they *do not* extend according to the demand, and more than half of them consider chiefly the probable return on the investment necessitated, usually requiring a minimum guarantee of current consumed amounting to 20 or 25 per cent of the cost of making the extension. In several cases known to the writer political considerations have beyond a doubt caused long extensions to be made which were certainly not justified. But, as a usual thing, the managers of municipal lighting, in order to make as good a showing for the year as possible, refuse to make extensions which will not be clearly profitable. And in this policy they are probably justified, for the aggrieved party can have the matter voted upon at the town meeting, or can refer it to the city government, in which case he may be sustained, if his cause is just, — or if he has sufficient "pull," — while otherwise he will be forced to go without service. The State law, as previously discussed, does not appear to exercise compulsion over municipalities in this matter. Again, the prospective customer may be charged part or all of the cost of making the extension, at any rate if on private land, and in case he refuses to bear this cost he can be denied service. While there is, of course, the remote possibility of securing action by the municipality,

yet the outcome in either of these cases usually is that extensions are by no means promptly made and that small customers are discouraged unless they happen to be conveniently located.

The companies for the most part maintain that they make extensions according to the demand, though they try to secure a reasonable minimum guarantee whenever possible. This guarantee was usually found to be considerably lower than in the case of the public plants. They also sometimes charge up part of the cost of extension to the customer, or let him pay for the transformer or for his meter. But as a rule their policy is, and from the very nature of the case *must be*, more liberal than that of the other group, for there is no buffer between them and the consumer corresponding to the town meeting or the municipal government. Rather, they are put constantly on the defensive, and can at any time be forced by the State Board to furnish service, whether they will or no. Hence, in an effort to avoid the disagreeable publicity and the ensuing prejudice which result from an appeal to the Board, they usually endeavor to keep the people satisfied. Appeals for extensions have been comparatively few in recent years.

3. Consumption

There will always be customers who are afraid that their meters are registering too much current, and who cause those in the lighting business a great amount of annoyance. In order to keep the peace, for according to law such persons can complain to the State Board, many companies find it desirable to do a good deal of really unnecessary testing of meters. It is also probable that a certain class of customers are naturally more suspicious of a private concern than of a municipality. At any rate, most of the companies report regular tests at reasonable intervals. The public plants, also, though seven report "no tests" or only "upon complaint," appear to be giving

more attention than formerly to this aspect of their service. As an example of the need for more care in this regard, the case of a large municipal plant may be cited, which, upon a change of management, tested all of the customers' meters, of which 47 per cent were found to be accurate, 7 per cent from 2 to 26 per cent fast, and the remaining 46 per cent from 2 to 100 per cent slow!

Customers' complaints appear to be reasonably well attended to by both groups, though the municipal plants can be more independent in the matter, and the manager frequently can, if he wishes, hide behind the municipal light board or the municipal government. Overlapping jurisdiction in such cases sometimes causes unwarranted delay in attending to complaints.

All of the companies report the sale of appliances, and several sell fixtures, while four or five public plants sell few appliances or none at all, and only one sells fixtures. The latter are much handicapped in this matter because they as a rule have little or no display room. The terms are about the same in both cases — "at cost" or "near cost." Some of the companies, however, offer liberal credit in order to push the use of various devices, and thus increase the day load. The public plants, as might be expected, are not usually so liberal in this regard, though the largest one of all maintains a little shop where household appliances, such as irons, are repaired free of charge. The manager deems it more advantageous in this case to be constantly selling current than to secure the usual fees for repairs or to have the appliances discarded as so often happens.

Deposits are usually required in both groups at the discretion of the manager or from tenants. Accounts are always collected monthly by the companies; but, for the lighting customers in a few of the smaller municipal plants, at intervals of two or even three months. The latter in two cases also make large use of prepayment meters.

In a few cases special rates are made to large consumers

of power, but for the most part the usual schedules are followed. All of the municipalities report general satis-

TABLE 56. PETITIONS OF MUNICIPAL GOVERNMENT, CITIZENS, OR CONSUMERS REGARDING PRICE OR QUALITY OF SERVICE SINCE 1910, AND ACTION OF STATE BOARD THEREON [1]

Name	*Date*	*Petition*	*Action of board*
I. Private plants:			
A. Generating—			
Beverly	1910		Board does not sustain consumer's petition for reduction in price
	1914	Petition of mayor for reduction in price	No action, but rate reduced in 1915 from 11¢ to 10¢
Newburyport	1910		Reduction in maximum net rate ordered from 15¢ to 14¢
	1912	Petition of consumers for reduction in price	
	1913	do.	No action
	1914	do.	
	1915	do.	
North Adams	1910	Petition of consumers for reduction	
	1911		Reduction ordered from 13.5¢ to 12.5¢
Northampton	1913	Petition of mayor for reduction in price	
	1914		Reduction ordered from 14¢ to 9¢
Plymouth	1910	Petition of selectmen regarding quality and price	
	1911		Reduction ordered in price of street lights
Quincy	1913	Petition of Board of Trade and citizens for reduction in price	
	1914		No action
	1915		
Vineyard	1915	Petition of consumers for investigation of rates and service	
	1916		Board for most part sustains company
B. Purchasing—			
Milford	1914	Petition of selectmen and consumers for reduction	
	1915		Reduction ordered from 18¢ to 14¢
II. Municipal plants:			
Hull	1915	Petition of consumers for reduction in price and improvement in service	No action; but rates reduced in 1916 from 20¢ and 15¢ to 17¢ and 14¢
Taunton	1913	Petition of citizens for reduction in price	No action; but rate reduced in 1914 from 13¢ to 9.9¢

[1] Table includes only the groups of plants studied.

faction with the rates at present, while a few of the companies admit that their charges are considered high. Yet, within the last seven years, as shown by the accompanying table (56), there has been but little active agitation for reductions in price, and in only four cases out of the seven listed did the Board, after careful deliberation, sustain the petitioners. On the other hand, there have been within the period numerous voluntary reductions in price,

TABLE 57. VOLUNTARY REDUCTIONS IN MAXIMUM NET COMMERCIAL LIGHTING RATES SINCE 1910 (CENTS PER K.W.H.)

Municipality	1910	1911	1912	1913	1914	1915	1916
I. Generating —							
Braintree	....	....	....	12 to 10	....	....	....
Chicopee	....	....	....	....	12 to 9.6	....	9.6 to 9
Concord	....	10 to 9	....	....	....	....	....
Danvers	....	....	....	....	....	....	....
Holyoke	....	....	....	8 to 6	....	....	....
Hudson	....	....	....	15 to 10	....	....	....
Hull	....	....	....	....	....	....	20 to 14
Ipswich	....	....	....	....	....	....	10.8 to 10
Mansfield	....	....	....	15 to 11.7	....	....	....
Marblehead	....	....	....	12 to 11	....	....	....
Merrimac	....	....	....	....	....	....	....
Middleborough	....	....	....	....	....	....	....
N. Attleborough	....	....	....	....	13.5 to 12	....	12 to 10
Peabody	....	....	12.35 to 11.7	....	11.7 to 10.8	....	....
Reading	....	....	12.8 to 10.8	....	....	10.8 to 9.9	....
Taunton	....	....	....	....	13 to 9.9	....	....
Wakefield	....	....	....	....	15 to 12	....	....
Westfield	....	....	10.8 to 10	....	10 to 7	....	....[1]
II. Purchasing —							
Ashburnham	....	....	15 to 12	....	....	....	....
Belmont	....	....	....	12 to 11.2	....	11.2 to 10	....
Boylston	....	....	....	....	....	....	....
Georgetown	....	....	....	....	....	....	....
Groton	....	....	....	....	14.4 to 13.5	13.5 to 11.7	....
Groveland	....	15 to 12	....	....	....	....	12 to 11
Hingham	....	....	....	....	....	....	....
Holden	....	....	....	....	....	....	....
Littleton	....	....	....	....	....	....	....
Lunenburg	....	....	....	....	....	....	....
Middleton	....	....	....	....	....	....	....
Norwood	....	15 to 11	11 to 9	....	....	....	....
Paxton	....	....	....	....	....	....	....
Princeton	....	....	....	....	....	....	....
Rowley	....	....	....	....	....	15 to 12.5	....
Shrewsbury	....	....	15 to 13	....	13 to 10.8	....	....
South Hadley	....	....	....	....	....	....	13.5 to 11.7
Sterling	....	....	....	....	....	....	....
Templeton	....	....	15 to 11	....	....	....	....
Wellesley	....	....	10.8 to 10	10 to 9	9 to 8.5	....	....
West Boylston	....	....	....	....	....	....	....

[1] Increased in 1917 to 9 cents.

amounting to twenty-four instances in fourteen different generating plants. The writer has also been informed of two or three additional reductions which have taken effect recently. Thus the total number of price reductions appears to have been at least thirty. The corresponding group of municipal plants have in the same period also made twenty voluntary reductions in price in fifteen different plants, while two, at least, have been forced from financial reasons to increase their rates.

There were a few complaints about the quality of service rendered by the municipal plants, and there would probably have been more had they not been publicly

TABLE 58. VOLUNTARY REDUCTIONS IN MAXIMUM NET COMMERCIAL LIGHTING RATES SINCE 1910 (CENTS PER K.W.H.)

Company	1910	1911	1912	1913	1914	1915	1916
I. Generating —							
Amesbury	....	....	....	18 to 16	....	....	....
Attleborough	....	15 to 14	14 to 13	13 to 12	12 to 11	....	....
Beverly	....	....	12 to 11	....	....	....	11 to 10
Buzzard's Bay	....	....	27 to 17.5	....	....	....	....
Citizens'	....	....	....	....	....	....	....
Gloucester	....	....	18 to 14	....	14 to 10	....	....
Great Barrington	....	....	....	....	....	....	14.4 to 14
Lee	....	....	....	....	....	....	....
Leominster	18 to 16	16 to 15	15 to 14	....	14 to 12	....	....
Newburyport	....	....	....	....	14 to 13	....	....
North Adams	....	....	....	....	....	12.5 to 11	....
Northampton	....	15 to 14	....	....	....	....	....
Plymouth	....	....	16.2 to 14.4	....	....	....	14.4 to 13.5
Quincy	17 to 15	....	15 to 13.5	....	....	....	....
Vineyard	....	....	27 to 17.5	....	....	....	....
Weymouth	....	....	....	....	....	....	....
Winchendon	....	....	20 to 12	....	....	....	....
II. Purchasing —							
Ayer	....	....	....	18 to 17	....	17 to 15	....
Blackstone	....	....	....	....	15 to 14	....	14 to 13.5
Franklin	....	....	....	12 to 9.9	....	....	....
Harvard	....	....	....	....	....	....	....
Ludlow	....	....	....	....	....	....	....
Manchester	....	....	....	....	....	....	....
Milford	....	19 to 18	....	....	....	....	14 to 10
Mill River	....	....	....	....	....	....	....
North Brookfield	....	....	....	....	15.3 to 15	....	....
Provincetown	....	....	....	....	....	....	....
Randolph	....	....	....	....	....	....	....
Shirley	....	....	....	....	....	....	....
Spencer	....	....	....	....	....	....	....
Sunderland	....	....	....	20 to 13.5	....	....	....
Ware	....	....	20 to 15.3	....	15.3 to 15	....	....
Williamstown	....	....	13.5 to 13	....	....	13 to 12	....

owned, for people usually complain less about inconveniences of their own making than about those which are imposed upon them by others. With one or two exceptions there seemed to be little complaint regarding the service furnished by the companies, and in many cases it was spoken of in the most appreciative terms.

Finally, it is interesting to note that while the private plants usually watch their street lights carefully, generally keeping a man on inspection duty or on call every night, the public plants seem for the most part to depend upon citizens or policemen to report outages, etc., and then attend to the matter when circumstances render it convenient. This, again, is explained by the fact that one who serves himself is naturally less particular than one who hires the service of others.

4. Financial Matters

As a large number of the questions on the schedule under the head of "Financial and Miscellaneous" apply solely to municipal plants, these will be first discussed. It was found to be necessary to ask very specifically regarding the various kinds of free service received, because the managers of municipal plants seemed to regard as their rightful prerogatives any free services which they had customarily received from the municipality, even though the electric plant rendered no service in return.

Aside from street lighting, there were only one or two instances worth noting of free service furnished to the municipality, and this was in connection with the fire alarm. It was, however, true in several cases that the rates charged for lighting public buildings and for public power are somewhat lower than in fairness to the other consumers they should be. But the writer was gratified to find that in at least seven cases the public plants are now charging to the municipality at a fixed rate per lamp or per kilowatt hour the cost of street lighting; and all of

the managers expressed themselves as favoring this policy. In all cases, current which is charged against the public authorities is regularly billed and paid for.

In two or three cases the city water used was not paid for at all, and in a few others it was secured at a special low rate. Telephone and transportation service appeared to be always properly charged up to the department, though the matter remains doubtful in some instances where the office is located in the town hall. Only one plant pays a part of the salary of the town or city treasurer, though all must utilize this department to a greater or less extent. Two plants report that the services of the solicitor are paid for if needed. Most managers, however, affirm that if they must have legal assistance they prefer to put their case in the hands of a *real* lawyer rather than to take a chance on the city solicitor, who is often a man of little experience or ability.

Half of the plants of this group occupy offices in the town hall for which they pay no rent, while in one or two other cases a portion of the operating expenses of the hall is shared by the electric light department. Four or five report the use of public land rent free. When the help of employees of other municipal departments is used, the usual rates of wages are paid according to the statement of the managers. In two or three cases the town, under a blanket policy, pays the premiums on all or practically all of the insurance carried by the plant. In one town the salaries of the municipal light board [1] are paid by the municipality, and in the thirteen instances in which the accounts are audited by the public auditor, the town and not the lighting department bears the expense. The police and fire-alarm service is in practically every instance at present operated as a separate undertaking.

The total amount of free service rendered by the municipal plants, if street lighting be excepted, appeared to

[1] Under the name of the "Commissioners of Public Works."

amount to little more than $500 annually, and probably an equal amount is given in various ways by the companies to the municipalities in which they are located. If Holyoke be excluded, the free service received would probably amount to somewhat more than $5,000 for the seventeen plants, or, including the cost of auditing, which it is rather difficult to estimate, from $7,000 to $8,000. In addition, if the salary of the town and city treasurers could be fairly apportioned to the lighting departments according to the services which they perform, — the work of well-paid officers in all private plants, — we would have to add at least a few thousand dollars more to this estimate.[1] (The case of Holyoke is somewhat different from that of the other plants, because the extensive offices used, covering an entire floor of the large city hall, were fitted up at the expense of the lighting department. The manager accordingly maintains that the reasonable allowance for this free service would be simply the interest on the investment made by the plant, or about $1,000. The writer views the case somewhat differently, however, and feels that a reasonable allowance should also be made for the quarters themselves, even though they were unsatisfactory before the department had expended money on them. In view of all the circumstances, $4,000 would seem to be a fair estimate.)

When the municipal plant is operated in connection with a water-supply system, an attempt seems to be made to keep the operating accounts fairly divided, except that the water used is rarely paid for. So far as the capital account is concerned, the theory usually held is that, provided the building was already erected for the use of the water department, none of its cost should be charged up

[1] This, of course, does not include the taxes foregone by the community, and no allowance is made for the assessment of a portion of the salary and expenses of the Board of Gas and Electric Light Commissioners as first provided for in sections 3 and 4 of chapter 205 of the General Acts (1917).

to the lighting department. No companies were being operated under these conditions.

In only two or three cases in each group does there appear to have been any conspicuous waste or extravagance in operation. Nor do the instances of extravagance or carelessness in investment seem to have been more numerous, though it must be admitted, after examination, that at least two municipalities obviously paid too much for the property which they were compelled by law to take over from private concerns. On the other hand, nearly half of the municipal plants were candid enough to admit that their financial policy, for reasons more or less beyond their control, had probably been too conservative for their own good and for the best interests of the public. Most of the companies seemed to feel that they had been sufficiently liberal in this regard.

The private plants in the main assert that their construction accounts are reasonably correct, though the writer is pretty certain that in a few cases they are surely too high. Nearly half of the public plants, however, admitted that their accounts are probably too low, inasmuch as many renewals in the nature of improvements are charged up to operation, when logically a part should be charged to the capital account, as would be done in the case of most companies. Some even stated that they follow the practice of including the cost of the smaller extensions in the maintenance expenses, in order to keep the apparent investment as low as possible. Further, many of the expenses of labor and superintendence during construction and extensions have at one time and another been met out of operation cash. Finally, additions from depreciation fund or from income have frequently not been properly accounted for.

Upon the whole, the aim of the managers of municipal plants seems to be to keep the investment account as low as possible because of the psychological effect which this

apparent economy has upon the citizens. Many a one has stated to the writer that he is not free to use his own judgment in the matter, as the public will not stand for it — a fact which also explains the failure, in many instances, to replace antiquated equipment, or, on the other hand, the purchase of second-rate equipment. In accordance with the requirements of the State law, the accounts are kept in such a way that the most intelligent taxpayer scarcely knows whether the plant is making or losing money in operation from year to year. Under these circumstances, it is comparatively easy for a manager to secure a sufficiently large annual appropriation to cover the cost of "street lighting," which may also cover an inexcusably large operating deficit. There is more than one road to Rome! It is much more difficult, however, to persuade the people in a town meeting that it is necessary to issue more bonds or notes, for *that* is something tangible and understandable, and such funded debt saddles the municipality with a constant and definite outlay for interest and maturing principal.

In the matter of depreciation all of the municipal plants but two go through the formality of having a real fund as the law requires, usually investing it annually in the plant for renewals and improvements or extensions. The companies, however, are, as suggested in another connection, very irregular in this regard, most admitting that depreciation to the extent of at least 5 per cent annually should be carefully taken care of, but maintaining that the device of a depreciation fund is somewhat of an anomaly. The usual policy is to write off the books at indefinite intervals when the earnings have been unusually good, and to endeavor to keep the plant in first-class operating condition, without following any definite theory. In view of the present trend of regulation of public utility rates, they are, from a private point of view, probably justified in keeping the capital account as large as possible.

A publicly owned plant occupies a somewhat unique position in this respect. Naturally, a company may cease to generate current and even let its equipment run down without impairing in any direct way the interests of the stockholders, even though the tangible assets become of small value, *provided the earnings continue to be at the same old level;* for the market value of the stock is for the most part merely an index of the rate of dividends paid. A municipal plant, on the other hand, which has suffered its equipment to deteriorate or has abandoned its generating station, may, if it has not built up a large reserve, — invested in the plant, if you will, — be left with a large debt on its hands which will be a burden to the taxpayers or consumers long after the tangible property and the equity in the plant are destroyed. To be sure, the rates may be made high enough to cover all of the fixed charges for principal and interest, until the debt is wiped out. But if this is done, should we not expect the municipal plants in the future to be compelled to charge considerably higher rates than the companies, which do not have such heavy fixed charges to carry, and which can, without impairing their own earnings, give the public the benefit of the decreased costs resulting from extensive hydro-electric generation? The 3 per cent rate of depreciation, legally required to be written off in the case of municipal plants, is ridiculously small in view of the rapid depreciation from obsolescence which *has* characterized and *still* marks the electric light and power business. Would it not have been wiser for public plants to provide for this inevitable depreciation by charging somewhat higher rates in the past, rather than, by postponing it, to keep up the rates in the years to come when the charges logically should be lower? But the people at a given time would hardly stand for such a far-sighted policy, and the next generation cannot well dictate what shall be its inheritance.

As nearly as can be estimated, the investment in equip-

ment which is no longer needed by the seven municipal plants which now purchase their current would amount to between $400,000 and $500,000. The plants themselves do not place the figure so high, because they consider that, so long as they still make use of the original station to receive and distribute their purchased current, only the machinery itself should be regarded as "not in use." They further maintain that if the equipment is being kept in readiness for emergency generation it is still "in use." However, having made ample allowance for the sort of stations and equipment that would be needed had current never been generated, and having deducted the probable scrap value, the writer feels that his estimate, based upon the depreciated plant accounts, is a very fair one. Were the actual construction accounts used as a basis of calculation, the amount would be considerably higher. A similar method of estimating would put the investment in dead assets of the three companies at between $300,000 and $400,000.

The accounts kept by the public plants are as a rule much simpler than those of the centrally controlled companies. All of the accounts appear to be audited, at intervals varying from one month to a year. The former are in most cases audited by the public accountant, though in five instances outside parties are called in to do the work. Their usual audit is frequently of a superficial, perfunctory sort. The books of the companies, when under group control, are examined by representatives of the central office; otherwise certified public accountants usually do the work.

The usual precautions against financial dishonesty are the audit and the bonding of responsible employees. Five managers of public generating plants, however, and six of the group of purchasing plants were not under bond in 1915, despite the requirements of the law,[1] and in many

[1] Mass., 1914, ch. 742, sect. 113.

cases the amount of the bond is low in comparison with the amount of money handled. There is also frequently an additional check by means of the fact that at one time or another practically all money passes through the hands of the town or city treasurer. Though in cases where the manager is a member of the municipal light board or one of the selectmen, as occasionally happens, it might be comparatively easy to introduce dishonest practices, the writer has no reason for thinking that there have been any serious misappropriations of funds in either group of plants. In fact the conduct and regulation of the business is for the most part such that this would scarcely be possible on any large scale. Whatever dishonesty there may be usually comes about in another way, which will presently be mentioned.

Summary

Some of the important findings thus far gained by means of the local survey, may be briefly stated as follows:

1. The municipal plants very frequently complained of inadequate boiler capacity.

2. There was a conspicuous absence of the various economic appliances in both groups, but this lack was more pronounced in the public plants.

3. The generating equipment of the municipal plants was frequently in far worse condition than would have been expected; in numerous instances second-hand apparatus had been originally installed.

4. The station meters appear to be regularly tested by the companies, but in the main very irregularly tested by the other group.

5. The "housekeeping" of the companies was usually better than that of the municipal plants.

6. The stations of a large number of the public plants were too small, badly ventilated, or much out of date. The companies, on the other hand, usually presented a satisfactory condition in this regard.

7. While most of the private plants had, in 1915, made adequate preparation for the present and the near future, most of the municipal plants were decidedly unequal to the demands which might reasonably have been made upon them.

8. The investment of the public plants would have been markedly increased had not a large number (7 out of 18) ceased generating current between 1915 and 1917. Many were decidedly "at the end of their string" in a physical way.

9. Many of the remaining municipal plants will soon be compelled greatly to increase their station investment unless they decide to purchase their current for the future.

10. The topographical conditions seem to be decidedly favorable to the public plants.

11. The companies usually appear to have a more satisfactory line construction, and they have a more accurate record of the length of their lines, their poles, etc.

12. In the matter of making extensions for new business, the private plants, being more subject to adverse public opinion and legal pressure, seem to be more liberal than the other group.

13. Much more attention is given to the sale of appliances of all kinds by the companies.

14. There appears to be more careful attention paid to the street lighting service by the companies, and usually a more expeditious method of handling customers' complaints.

15. There have been more numerous voluntary reductions in rates by the companies than by the municipal plants.

16. While practically no free service is now rendered by the public plants to their communities, a good deal of unpaid service of various kinds is still furnished by the

municipalities to their plants, the actual value of which it is very difficult to estimate.

17. The financial policy of the municipal plants, according to their own admission, has in numerous cases been too conservative.

18. A large proportion of the public plants admit that their construction accounts are too low, as they purposely follow the policy of keeping them down, because of the effect which this *apparent* economy has upon the citizens. Often capital charges have been included in the operating accounts, which otherwise have usually tended to be relatively low.

19. There is probably an investment of about $500,000 in the "dead assets" of municipal plants which have ceased to generate current. This fact should not be overlooked if we wish to know the *real* financial results of public ownership.

CHAPTER XII

THE LOCAL BACKGROUND: GENERATING PLANTS (*concluded*)

5. The Management

From the very nature of the survey the questions listed under this head refer only incidentally to the management of private plants. Hence, unless specifically indicated otherwise, the discussion will apply to the *public* plants.

There are no municipal light boards in the *cities*, with the exception of Chicopee, which has secured one through special legislation. In Hull the selectmen serve as a board, and in Hudson the commissioners of public works. While members of the board frequently hold other public offices, politics do not seem to have been much considered in their election. In only about a third of the cases did one or more of the members appear to have what might be called a technical knowledge of the electric light and power business. The remainder are for the most part business men. In some instances the boards take a very active interest in the department, even more than would seem to be warranted; but for the most part the manager is left in practically full control. The law is not altogether specific as to how the division of responsibility should be made.[1] In three cases the manager is also a member of the board (1915).

One of the managers (Holyoke) is under the civil service, two are appointed by the mayor, and the remaining by the municipal light boards, if there are such. The term of appointment seems actually to be indefinite in

[1] On this point the reader is referred to chapter II, *supra*, and to Mass., 1914, ch. 742, sects. 112, 113.

about half the cases; in six or seven others it is definitely only one year; while in two of the cities the manager holds for three years. With few exceptions it seems to be the policy to retain the manager for a considerable length of time. The period of service for the present managers varies from one to nearly twenty years; while the average length of service of all is from eight to ten years. The basis of selection appears in most cases to be general fitness for the work, rather than any political considerations. In some cases, however, particularly in the past, politics have played a part, leading to the appointment of wholly incompetent men, and in one or two instances religious considerations were apparently involved.

It is interesting to note the technical qualifications of these managers. Two in the smaller plants appear to have no training of any sort which would fit them for the work, and some years ago such cases were by no means uncommon. Four have secured all of their training in the plant itself, having worked up from the lowest positions. The remaining two thirds began their career in the service of private concerns, usually in electric light and power plants in the State; but one had been with the Commonwealth Edison Company of Chicago, and two or three with the General Electric Company.

The writer was highly gratified to find, in addition, that five[1] managers of municipal plants are graduates of the Massachusetts Institute of Technology, one of the Engineering Department of Tufts College, while a seventh had completed most of the work for a degree in engineering at McGill University. Still another has had about two years of college work along other lines. Most of the remaining have had high-school educations, and a few have endeavored in addition to improve themselves along technical lines by means of correspondence courses. In the group of companies, on the other hand, only two

[1] Including one manager of a plant which purchases current.

or three local managers or superintendents were found who are technical graduates, though all have evidently had a reasonably satisfactory general education and are first-class practical men, having spent most of their lives in the business. These facts would seem to indicate that the position of manager of municipal electric lighting is not unattractive to men of some education, and that, contrary to the common assertion, the larger municipal plants probably now have fully as intelligent management as have the private plants, except in so far as the latter may gain by central control.

Only six out of eighteen municipal managers are members of one or more technical societies, such as the American Institute of Electrical Engineers, while eight out of ten managers or superintendents of companies have such affiliations. The reasons for the poor showing made by the former in this regard are numerous. In the first place, they are not allowed by the by-laws of the organization to become members of the National Electric Light Association, though the New England Section is well disposed toward them and invites them regularly to its meetings — a courtesy of which a few avail themselves. Again, many feel that their salaries are not sufficient to justify their incurring the expense of dues and annual meetings of such societies, for while companies commonly themselves bear this charge, municipalities follow no such practice. In the third place, most of them feel that there is a decided antagonism on the part of the citizens against any affiliations with interests which are naturally opposed to the principle of public ownership. Many, also, find that the public do not look with approval upon their being absent for a short time in order to attend such meetings — the feeling being that they are merely away "having a good time" instead of attending to business. And, finally, some of the managers, very conscientious in the performance of their duties and feeling their re-

sponsibilities keenly, do not consider that they should spare the time or run the risk of having some accident happen during their absence. Hence, it is not surprising that so few belong to scientific societies. There is, however, a State Association of Managers of Municipal Lighting, which has one or two informal outings each year at which views can be interchanged, and where, the writer is pleased to state, much real good cheer is in evidence.

As to the political activities of the managers of public plants the writer is not in a position to speak with absolute proof as to the conditions in the past. It appears, however, that there is less undesirable manifestation of this sort now than formerly, though in two cases recently the manager has beyond a doubt dabbled in the game, and in three or four others there is ground for suspicion. More than half of them state definitely that they have not been interfered with for political reasons. Three admit that politics at present make the work very unpleasant; while three others affirm that they were formerly thus troubled. The nature of this interference would be rather hard to define. In some cases it takes the form of an attempt at favoritism, and in others it is marked by an effort, for ulterior motives, to limit the manager in the use of his judgment as to the proper operating or financial policy. Frequently, also, he is hampered more by the ignorance of the citizens regarding technical matters, than by any sinister political manipulation. Managers of private plants have their difficulties as well, though usually of a different sort. The chief weapons to be used against a company are complaints about price or quality of service.

Three or four cases were found in which the municipal manager does not give all of his time to the work, and in a number of cases he also performs the duty of inspector of wires, thus somewhat increasing his salary. It seems rather anomalous, however, for him to hold this posi-

tion. In several cases he also has charge of the water system, for which he receives additional compensation.

The salary of two or three of the municipal managers is ridiculously low, while in one or two other cases it appears to be disproportionately high.[1] Upon the whole, however, the writer does not feel that at present, a number of increases having been made since 1915, the salaries are unreasonably low, considering the qualifications and abilities of the men and the work which they are expected to do. No attempt was made to secure definite figures regarding the salaries paid by all of the companies, though they seem to run slightly higher than in the municipal plants. But it must be remembered in this connection that the local manager of a company, particularly of one which is centrally controlled, is relieved of many of the annoying responsibilities which are imposed upon a manager of municipal lighting, nor does he need to be so sensitive to the popular will.

Ten managers state that they are given practically full authority (as previously indicated), while the others to a greater or less degree are controlled by the mayor or by the municipal light board. With a few exceptions an honest attempt seems to have been made to use wisely the authority granted. Materials are for the most part purchased directly by the manager, though it is not uncommon for the board's approval to be required for expenditures above a certain amount — usually five hundred dollars. For the large purchases the practice of securing competitive bids is usually followed. Local dealers do not seem to be favored ordinarily unless the difference in price is slight or the deliveries much more prompt. In most cases, however, the question does not arise. Many managers complain that they are prevented from secur-

[1] Cf. Mass., 1914, ch. 742, sect. 113. The amount of compensation, as well as the term of office, is to be fixed by the city council or by the selectmen or municipal light board or similar body.

ing material when it might be bought to best advantage, because of the fact that the appropriations do not come at the right time and there is no surplus fund to draw upon.

For the companies which are centrally controlled, as well as for some of the remaining, material is bought by a purchasing agent, who is usually given wide discretion. They also customarily place their contracts through competitive bidding. Some years ago, however, it was common for a number of companies on the list to purchase material from a supply company, which was owned by those having the chief interest in the lighting plant. This practice seems now to have been effectively frowned down by the Board of Gas and Electric Light Commissioners.

To some it may seem extremely futile for one in the position of the writer to ask a manager whether any one has ever tried to corrupt him, or in lieu of that to endeavor to discover the fault from other dependable sources. There are, however, more ways than one of finding out pretty accurately whether one holding a responsible position is gifted with an itching palm, though it is practically impossible to prove a case of this sort.

At any rate, about half of the municipal managers either admitted that some time during their tenure they had been offered graft of one sort or another, or they suggested that they knew of managers who had been dishonest. Naturally no one could be expected to incriminate himself and the practice is surely not so common as it used to be. Yet one man stated that he received the "usual discounts" when purchasing certain material. Another volunteered that, in making a sale of a lot of wire which had been scrapped, he had been offered one thousand dollars if he would permit the purchaser to do the weighing. Others have spoken of the offer of certain percentages on the cost of installation of some particular type of machinery — though it is practically certain that none of the standard concerns would use such tactics.

The commonest method of approach, however, is the offer of a "rake-off" on coal purchased, which usually amounts to billing a certain grade and substituting an inferior grade. Several managers stated that they had been offered such inducements, and that they well knew cases in which the graft had been accepted. The most patent case of dishonesty brought to the writer's attention was that practiced by a manager who was also interested in a coal yard. He is said to have been able to retire with a considerable fortune after a few years. In one case, also, and that a very important one, as nearly as can be ascertained without having been a party to the transaction, it has been customary for the manager to pay roundly in order to secure his position, which carries an absurdly low salary, and then to piece out his stipend and earn back his purchase money by the usual graft. It is said that an honest dealer had no opportunity to sell his goods to this plant, and the present unsatisfactory condition of comparatively new equipment, as well as the formerly excessively high operating expenses, appear to bear witness to the truth of the charges which have been made by numerous creditable persons who were in a position to know. The condition of affairs in this particular place was and is practically an open secret. Here the lighting plant has almost always been regarded as the football of the municipal government. Conditions are still unspeakably *rotten*, though little if any of the blame at present rests upon the manager.

So far as concerns the municipal light boards or other municipal authorities which ultimately control the lighting situation, the writer knows that in several cases their integrity has been by no means unimpeachable. In one instance a board is said on good authority to have refused to install a certain excellent piece of equipment because the dealer would not give the bribe which they rather naïvely asserted they were in the habit of receiving.

In another case some members of a board, who were securing bids for an important piece of extension, won heavily at poker one night from one of the agents who was eager to put through a deal for his house. As might be supposed, that sealed the contract; but as a sequel it should be stated that the work when completed was far from satisfactory to the public.

Other cases of crookedness might be mentioned. Yet it is needless to multiply these examples, for probably most of them could be duplicated under private management if the proper channels of information were sounded. As a general proposition, however, it would seem that, excepting Holyoke and one or two other cases, the larger the municipality which has a plant of its own, the greater are the opportunities for dishonesty and the more frequently is it practiced. The *town*, with its old-fashioned methods and meetings, is evidently much freer from graft than the city.

Something more should be said, in conclusion, regarding the municipal managers. The writer was, in most cases, struck by the earnestness and conscientiousness with which they now perform their duties, some never giving themselves even a brief vacation. In most cases they seem to feel a sort of proprietorship in their plants, and they accordingly exert themselves to the utmost to make as good a showing as possible. To do this they must familiarize themselves with all aspects of the work, and must themselves often perform service which under private ownership would ordinarily be done by specialists.

With few exceptions, however, they feel that their position is an almost intolerably difficult one. On the one hand they have the public to satisfy — a public which believes that the manager is *its property*, which demands twenty-four hours of cheerful service each day, which all too readily criticizes the management if things go wrong and complacently accepts the credit for any success that

may be attained. On the other hand they have their ideals of the correct policy which should be followed for the present as well as for the future. In too many instances they are absolutely prevented from doing what they know should be done, either by the lighting board or the municipal government or by the adverse vote of a town meeting. They suffer most because of the ignorance of those who strive to direct their policy, i.e., *the people*, whose knowledge of the business, even among the more intelligent, rarely goes so far as the ability to read their own meters and to remember the price which they pay per kilowatt hour. They frequently grow discouraged and say, "What's the use?" — but still, with almost no exceptions, they keep everlastingly at it, making the best of bad circumstances and hoping for a better future.

By these words of appreciation the writer means to make no invidious comparisons with the managers of private plants. But he does wish to assert, and assert strongly, that, in spite of the mistakes of the past, the municipal managers as a class are at present striving for the same ends that are sought for in private business, and that if these ends are not attained, it is, with few exceptions, because of the inhibitions almost unavoidably set up by municipal ownership, rather than because they themselves are incompetent to perform the tasks which they have undertaken.

If this be the case, the reader may well ask why the managers remain in such an unsatisfactory position. Why do they not seek employment elsewhere? To this question the writer would reply that, in the first place, there is a certain satisfaction in wielding such *outwardly* full authority as is usually granted to the manager, and there is also a certain degree of prestige connected with the position. These facts have induced a number of reasonably good men to enter the municipal service because they grew tired of holding a more subordinate position under pri-

vate employ. Then, once having gotten into public service of this kind, it seems to be very difficult to go back into a private position. The managers themselves have constantly stated that a prejudice exists against them, and the writer has ascertained the truth of this claim by discussing the matter with many responsible men who are engaged in private business. They maintain that one who has grown accustomed to the public way of doing things, is as a result largely unfitted for usefulness in corporation work, in which the methods and the point of view have ordinarily been so very different.

Perhaps this prejudice is ungrounded, though the writer knows of only one or two cases in the State in which a man has stepped from the managership of a municipal plant to the employ of an electric company. Yet many managers with whom the matter has been discussed in confidence, have said that they are merely waiting to find a favorable opening in some private enterprise, and practically all say without hesitation that they would prefer to work for private interests. Their general feeling may be aptly summed up by saying, "It is hard to serve many masters."

6. The Employees

As was suggested in an earlier chapter, there is no uniformity followed in the method of returning the average number of laborers employed. Some give only the number *regularly* employed, while others list *all* who are employed, even though for only a portion of the year. In practically all instances the manager is supposed to hire the employees, though in one or two cases in each group the matter is left to the superintendents or foremen, who are subordinate to the manager. In the four *cities* having public plants, all except the laborers are under the civil service.[1]

There seems to be no particular discrimination against

[1] Cf. Mass. R.L., ch. 19, sect. 36, and Mass., 1902, ch. 544, sect. 13.

foreigners, though practically all of the companies employ them and scarcely half of the municipal plants do so.[1] In about two thirds of the municipalities in this group it does not appear, recently at any rate, that political considerations have influenced the appointment of employees. In four or five cases it is certain, however, that politics have played a more or less important part, while in one or two cases religious considerations have had some influence. In an equal number of instances, naturally, the employees have dabbled somewhat too freely in politics. Here, again, the larger plants have been troubled most.

Six employees of municipal plants were found, in addition to the managers, who have had what might be called a technical training, more or less complete. These, however, were confined to only two of the larger plants. About the same number of technically trained men were found in the private plants visited. Seven of the former group of employees, representing three different plants, are members of some State or National technical organization, while from twenty to twenty-five were found in the ten companies visited.

The eight-hour day is supposed to be in force in all of this group of public plants. In the companies, also, the majority are on the eight-hour shift, though two still have the nine-hour day, one, the ten-hour, and in two cases there is a twelve-hour shift for certain employees. There seems to be no noticeable difference in the rate of wages paid by the two groups. A few of the companies pay lower than the usual rate, and a few pay higher, while the municipal plants seem to adhere closely to the standard schedule. It must also be remembered that the private station employees have a far pleasanter place in which to work than have the corresponding public em-

[1] This is as would be expected as a result of the laws requiring preference to be given to citizens of the Commonwealth. Cf. Mass., 1914, ch. 600, sect. 1.

ployees. It is scarcely worth while to discuss the average rate of wages paid, beyond what has already been said in a preceding chapter, for during these abnormal times wages are being rapidly though irregularly increased by both groups. The usual rate paid for overtime work is time and a half, though in both cases there are plants which make no extra allowance, and one or two seem to pay nothing at all.[1]

According to the statements of the managers of municipal lighting, the services of employees of other municipal departments, such as the highway or water department, are utilized in only four or five cases, and then rarely. It is customary to pay for such labor at the usual rate.

For the most part the employees appear to be retained in both groups as long as they care to stay, provided, of course, that they do satisfactory work. As might be supposed, however, the firemen and common laborers are usually a rapidly changing lot. The power of discharge rests in practically all cases with the manager, though in two instances in municipal plants the authority is lodged in the hands of the superintendents or foremen. There is frequently an appeal from the decision of the manager to the municipal light board or the municipal government. There seems to be no appeal from the decision of a company's manager or superintendent. The ground for discharge commonly given is incompetency. In scattering instances, however, other reasons were stated as follows: "Negligence," "drunkenness," "sleeping on watch," "insubordination," "agitation for higher wages" (*sic*), and "politics."

[1] The writer is not certain that the plants in municipalities which have adopted the eight-hour day always adhere to the law. He knows of one instance in which the chief engineer, who has been with the plant almost from its beginning, has worked a total of two years' overtime within the last five years, but has never received one cent therefor. The law, with its penalties, may also be a dead letter in other cases. Cf. Mass., 1911, ch. 494, sects. 1 and 8.

In the majority of cases in both groups a two weeks' annual vacation is allowed with pay, as well as the customary holidays. Saturday half-holidays are more common among the public plants; but, on the other hand, two or three of these allow no regular vacations of any kind. Upon the whole, there seems to be little to choose between the two groups in this regard.

In the matter of sick leave with pay all of the companies appear to follow a liberal policy, laying down no specific rules, but providing particularly for their old employees, at the discretion of the manager or of the directors. Several cases were brought to the writer's attention in which faithful employees, unable to do their customary work, were kept on the pay-roll for a year or even longer. The fact that the returns made to the State Board do not disclose individual wages makes it possible to follow this practice without incurring the criticism which might otherwise arise, for there are always people who are suspicious and who would fear that wages paid to an employee, supposedly unable to work, might be a mere padding of the pay-roll for private purposes.

The municipal plants, on the contrary, are much less human in this regard. Three or four state definitely that they allow no sick leave with pay, five give two weeks, one a month, while the remainder follow no fixed policy, but leave the matter largely to the discretion of the manager, who is constantly under pressure to effect economies.[1] Without discussing at length the outcome of this policy, the following reasons, suggested by the managers them-

[1] The writer knows personally of one of these cases, "left to the discretion of the manager," in which an unusually faithful employee, who had served for about twenty-five years, having contracted a serious illness, which compelled him to lose three months' time, received not a cent of pay for the period of his sickness. This, to be sure, is an extreme case; but for personal or political reasons, it is possible for the matter of sick leave to be handled in a most arbitrary fashion by the manager of a municipal plant, or by the manager of a private plant as well.

selves, may be cited as explaining in large measure the illiberal attitude of public plants.

In the first place, the manager, who is constantly under the public eye, is made to feel that his tenure of office depends largely upon his making a good financial showing. He must by every means keep down expenses. Again, every one knows when a public employee is not working, and if the pay still goes on, *that* also is known. Hence, every opportunity arises for suspicion and false accusation. Finally, a conscientious manager, in order to avoid any appearance of favoritism, frequently carries himself so straight that he leans over backward. He may even work great injustice in an attempt to appear absolutely just. A company can do largely as it pleases in questions such as this, while in a municipal plant everybody's finger, directly or indirectly, sticks itself into the pie.

Half of the companies give some sort of present to their men at Christmas or Thanksgiving time, while this practice does not appear to exist in the public plants. With two or three exceptions, no well-defined attempt at welfare work was found in either group — in fact, one would hardly expect this in establishments which employ so few men.

From the nature of the work unionization is not common among the employees of the small electric plants. Yet in several instances in both groups it was found that the firemen's, engineers', or linemen's unions are in evidence. Though there does not appear to be any general opposition to union labor on the part of the management in either case, yet the employees are somewhat more highly organized in the municipal plants than in the companies. It hardly seemed worth while, for the purposes of this study, to endeavor to secure the exact number of union members.

In five or six municipal plants there have been recently some slight labor troubles, occasioned in the main by an agitation for higher wages. The management of the com-

panies did not admit that they had experienced any difficulty on this score. But several in each group stated that their employees were not altogether satisfied with their wages or the conditions of employment.

7. General Considerations

It was rather interesting at this date to make an attempt to discover why these municipalities of Massachusetts had originally entered upon the business of electric lighting. The general answer seems to be that they simply had a desire for municipal ownership, hoping to secure financial gains or better service therefrom. Of other specific answers given to this question the following may be suggested, together with the number of plants to which they in each case apply: "Unsatisfactory service of local company," four; "Private plant stopped generating," one; "The people needed electric service and there was no other way to obtain it," four; "Private lighting service had purposely been kept out of the territory," two; "Politics," one; influenced by the "General movement for municipal ownership," three.

In the case of the public plants the attitude of the municipal government seems to be favorable in all but three or four cases; nor does there appear to be any friction with other municipal departments. Only one case of direct hostility of the local government was found among the private plants, and in many instances the service of the companies was spoken of in terms of highest praise. In several places business men in general were evidently somewhat dissatisfied with municipal ownership; but no noticeable dissatisfaction was found so far as the other group is concerned, except that in two or three cases the prices were considered too high. The citizens as a body, so far as could be ascertained, are, with probably four or five exceptions, favorable toward public ownership where it now exists. Only two cases were found in which the

general attitude toward the private plants was either unfavorable or doubtful.

Politics, at one time or other, have interfered seriously in at least four municipal plants, and probably to some extent in as many more. In three or four cases also the companies have been troubled by politics.

While there is in almost all cases a gas company present in the territory, the relations appear to be for the most part pleasant, though the gas people are frequently much more active in pushing their business than are the electric light plants; and in some instances the former actually seem to have been gaining in the amount of house lighting done. In the case of the private plants, however, in eight instances out of thirteen the gas is supplied either by the electric plants studied, which are composite, or by companies which are under the same ownership. Under such circumstances there is not much opportunity for real competition.

All of the companies heard from in any way, except one, make a systematic effort to get new business, by means of soliciting, advertising, and campaigns of various sorts. Every one of the ten actually visited has a show-room with adequate facilities. Of the municipal plants, however, half admit that they make no effort whatever to secure new business, usually because they are not able to take care of what business they already have in a wholly satisfactory manner. Some rather naïvely state that they do not have to look for new business because the territory is already fully developed, or because their good service and low rates are a sufficient advertisement. Only three or four of this group have anything which even approaches a show-room. The remainder either keep no appliances on hand or have them hidden away in some corner of their crowded offices.

In comparatively few cases do the public plants furnish the major portion of the power used by factories in

their territory. As nearly as can be determined, however, the companies make a somewhat better showing. In view of the fact that many of the manufacturing concerns started business before the local lighting plants were installed, or before the commercial possibilities of central station generation were fully realized, it is not strange that many factories in either case are not supplied with power, particularly in those instances in which the demand is very large. There are also perfectly good reasons why it may not be financially expedient for an electric plant to increase its equipment sufficiently to take on very large power customers unless there is a definite guarantee for a period of years which will be high enough to enable a large part of the additional investment to be amortized. This is especially true in the case of new and untried enterprises or in the case of those factories the demand for whose product is occasioned by abnormal conditions, such as war, or is subject to the vagaries of fashion, or is dependent upon the good-will of a comparatively small group of consumers. Yet it is very evident that the public plants have been much more cautious than the companies in this regard, demanding in many cases unreasonably high guarantees, and upon the whole frequently assuming an attitude of careless indifference. In several instances it was clearly demonstrated that valuable business has been kept away through this policy. Probably the same thing has happened in other cases, though it is sometimes difficult to prove the actual occurrence. At any rate, in many instances, the public plants could now rapidly extend their power business if they had the facilities for doing so. No doubt a municipal plant is justified in running no risks; but the customary policy is an exceedingly short-sighted one, if the welfare of *all* the people is to be considered.

As to the future development of business in their territory, *all except one or two of the companies appear to have*

made reasonably adequate preparation; while in *only two or three instances have the public plants which are still generating current sufficiently provided for the future.* In at least half of the plants in this group the answer must be decidedly "*No*," and in several others it is very doubtful.

So far as concerns the objections to the present system and the suggestion of needed changes, practically all of the private plants answer "None," though one (the smallest of all) mentions that twenty-four-hour service is needed, and another admits the desirability of a general improvement in service. Only a third of the municipal plants, however, answer "None" to this question. The remainder admit that the objections and needed changes are manifold, among which may be listed the following: "More capacity needed," "Additional lines necessary," "Larger units," "Entire system should be renewed," "Too numerous to mention," "Administrative changes," "General objections," "More liberal financial policy," "Less cumbersome financial policy," "Do away with politics," "Street lights should be paid for." Probably these complaints of the managers speak for themselves.

The reader might object that the municipal managers may have been more frank in their admissions than the managers of the companies. This is a reasonable inference. But it must be remembered that the writer most carefully reviewed the entire situation from all angles and secured confirmatory proof of all statements before drawing any conclusions. Hence, in view of the fact that he has been on the ground personally and has inspected the plants and systems which are here discussed, he believes that the picture painted is as accurate as a reasonable, unbiased judgment can make it.

In several instances the writer discovered a well-marked desire for a change from public to private ownership, though the recently passed law [1] and the local pride

[1] Mass., 1917, ch. 205, sect. 1.

would probably prevent any transfer being made. In two cases the writer knows personally of negotiations which have been entered into for the purpose of taking over large municipal plants by private interests, having seen some of the estimates which had been drawn up in connection therewith. In both cases the incipient negotiations fell through — in one instance because it was found that no deal could be made without the payment of a large "sweetener" to the municipal authorities by way of graft. This, however, happened before the law was passed requiring the same sort of vote to be taken for abandoning a municipal plant as for acquiring it. In about two thirds of the cases in this group municipal ownership in a general way is termed a success by the managers, and in the others the answer is "Not a success" or "Doubtful." The reader can form his own opinion as to the adequacy of this judgment.

Most of the companies definitely state that there is no noticeable desire for a change to public ownership in their territory. As nearly as can be ascertained by careful inquiry, they have put the case correctly, though there are one or two reasonably doubtful cases. The accompanying table indicates that there has been practically no serious agitation for municipal ownership in the companies studied at any time. Accordingly, we may naturally expect that private ownership in these cases has been reasonably successful from a public point of view. Only one or two suggestions to the contrary were received; while frequently the warmest commendation was volunteered by wholly disinterested parties. The following extracts from a letter received by the writer from the mayor of one of the cities in which is located a company under consideration, is typical. The reference is to one of a group of centrally owned plants.

> Although I have no connection, financial or otherwise, with any of the companies (beyond being a private consumer in my own house), I am very familiar with their organization . . . .

TABLE 59. ACTION TAKEN REGARDING MUNICIPAL OWNERSHIP BY 33 CITIES AND TOWNS HAVING PRIVATE PLANTS (UNTIL 1917)[1]

Generating Companies				*Purchasing Companies*			
Place	*Action taken*			*Place*	*Action taken*		
	Within 5 years	*Between 5 and 10 years ago*	*More than 10 years ago*		*Within 5 years*	*Between 5 and 10 years ago*	*More than 10 years ago*
Amesbury	....	....	....	Ayer	....	....	....
Attleborough	....	....	....	Blackstone	....	....	....
Beverly	....	....	Adverse Com. Rept., 1897	Turner's Falls (Franklin)	....	....	....
Falmouth (Buzzard's Bay)	....	....	....	Harvard	....	....	....
Nantucket (Citizens')	....	....	....	Ludlow	....	....	....
Gloucester	....	....	....	Manchester	....	Voted to accept M.O. Act, 1908	Voted to accept M.O. Act, 1902
Great Barrington	....	....	....	Milford	Com. appointed to investigate, 1915. (Matters adjusted)	....	....
Lee	....	....	....			....	....
Leominster	Some agitation	....	Voted against acceptance of M.O. Act, 1905			....	....
Newburyport	Council voted to accept M.O. Act, 1912	(Some dissatisfaction under old management)	....	Williamsburg (Mill River)	....	....	....
North Adams	....	....	Adverse Com. Rept., 1906	North Brookfield	....	....	....
Northampton	....	Investigating Com. appointed, 1911	....	Provincetown	....	....	....
Plymouth	....	....	Investigating Com. appointed, 1891	Randolph	....	....	....
Quincy	Some agitation	....	Proposition referred to next city govt., 1905	Shirley	....	....	....
Oak Bluffs (Vineyard)	....	....	....	Spencer	Investigating Com., 1914. (Difficulties adjusted)	....	....
Weymouth	....	....	Subject indefinitely postponed, 1889			....	....
Winchendon	....	....	....	Sunderland	....	....	....
				Ware	....	....	....
				Williamstown	....	....	....

[1] Cf. Mass. G. & E. XXXII, 180-190.

The arrangement has met with general approval, I think, in all of the municipalities served. The rates are fair, and low. There is no doubt that the companies have made a good deal of money. But there can be no objection to this, because they have thoroughly modernized all of their plant with the money they have made from the consumers, and their service has been of a very high order. They have not mixed in politics in any way. Their local manager was for some time interested in local politics, he having served in our City Council; but his interest was entirely personal, and his service to the city was of value to it much more than to the company with which he was and is connected. He is a good business man, and as such gave freely of his brains and time to his city. . . .

The quality of service is first-class. Every complaint is promptly taken up, and remedied if possible. For instance, if a police officer reports a street light not burning, a man is at once sent to the spot and the trouble taken care of. It is the same with private complaints of private services.

Summary

We may conclude our summing-up of the more important evidence secured in the local survey as follows:

1. The managers of municipal electric lighting *at present* seem to be in most cases well qualified for their work, and their appointment appears to have been usually based upon their general fitness.

2. Few of these managers belong to technical societies of any sort.

3. With a few exceptions, there is no evidence that they dabble unduly in politics, though frequently they are somewhat interfered with for political reasons.

4. The salaries of the managers of municipal plants have recently been considerably increased, and in the main now seem to compare favorably with those paid to the managers of companies.

5. Numerous traces of dishonesty on the part of municipal managers or municipal lighting boards can be found, though probably the situation is not much worse, with a few exceptions, than might be expected under private ownership.

6. The managers of municipal lighting in general admit that they are highly dissatisfied with the conditions which they are forced to put up with under public employment.

7. The larger the municipality owning its plant, Holyoke excepted, the more numerous in general are the evidences of corruption and political interference.

8. Wages and hours of labor (usually eight) appear to be about the same in both cases, the public plants having in a few cases shorter hours.

9. The conditions of employment are frequently more pleasant in the companies, and they, in the main, seem to take better care of their labor.

10. The reasons given by municipalities for acquiring their plants are numerous, but most of them seem to have been moved by the hope of financial gains of some sort.

11. Practically all of the companies make an active attempt to get new business, while the majority of the public plants frankly admit that they make no such effort. They let business *come to them*. Though few of the latter do any advertising or make use of show-rooms, the former do so almost without exception.

12. In a number of cases the available evidence points to the fact that desirable business has been kept away from municipalities because of the failure of their publicly owned plants to offer adequate facilities for the supply of power. Many of these plants could also greatly increase their power business at the present time if they cared to do so.

13. In many regards a number of the municipal plants were laboring under serious difficulties at the time of this survey, and several would probably have been glad to change to private ownership had it not been for the legal complications. On the other hand, there seems to be at present little serious dissatisfaction with private ownership in the places served by the companies.

Brief Conclusion

Practically all of the data secured in this local survey of the generating plants (as outlined in this and the preceding chapter) amply confirm the tentative conclusions reached as a result of our careful analyses of the statistical material given in the annual returns. In many instances very valuable additional information has been collected. In general, the findings for this group of plants would seem to indicate clearly that public ownership, as compared with private management of the lighting business in Massachusetts, leaves much to be desired. It may be true, however, that at times certain not readily calculable gains have resulted.

CHAPTER XIII

THE LOCAL BACKGROUND: PURCHASING PLANTS

THE purchasing plants furnish little additional material of interest; but, consistent with our earlier treatment, it has seemed desirable to keep the results of the local survey of these plants separate from those of the generating plants. Accordingly, in the present chapter a very brief account will be given of this group in so far as the schedule applies or as it may seem necessary. As none of the municipal plants under consideration have ever generated current, and as all of the companies which formerly generated have definitely stopped this activity, many having disposed of their equipment, there is nothing to say regarding the central station.

1. DISTRIBUTION

In the matter of topography and geography it appears that there is little difference in the conditions surrounding the two groups of plants. In practically all cases the conditions would be considered normal.

Half of the companies claim to extend their lines according to the demand, and about half say that they think first of financial considerations. Some of the public plants also make extensions to meet the demand; but the answers usually given to this question are, "By vote of the town," "Board decides," "For a reasonable return," etc. Probably neither group takes on unprofitable customers when it can be avoided. Extensions, when finally decided upon, are, so far as known, made with reasonable promptness in both cases, though there is some evidence to point to the presumption that the municipal plants do not overexert themselves. In a considerable number of the latter,

and in one or two cases in the companies, the customers bear a part of the cost of extension, particularly on private land. The construction thus paid for does not in many cases appear to be charged to the capital account. A large proportion of the companies let out their extension work to contractors, while the municipal plants usually do the work themselves. This probably accounts in no small measure for the somewhat lower construction accounts of the latter, for not only is the total cost of a piece of work thus done frequently lower, but often, as indicated in an earlier chapter, the labor used in new construction is charged up to operating expenses.

It was difficult in this case, as in the generating plants, to find out with accuracy how many poles are actually owned and how many foreign poles are used. It appears, however, that the writer was partially wrong in his earlier inference from the returns to the effect that the public purchasing plants own practically all of the poles which they use. The proportion seems to be little higher than in the case of the generating plants, though the companies of this group own comparatively a larger number. Practically none of the municipal plants pay any pole rent, while almost all of the companies must provide for this item of expense.

The larger plants in each group have a fairly accurate knowledge of the length of their lines and streets with overhead lines, secured through actual measurement or by scaling from blue-prints of the town. For the smaller plants of recent installation the length given is also approximately correct. Few in either case have a satisfactory map of the distributing system. Connected load is, as would be expected, merely a rough estimate in most cases.

In general it is probably true that the distributing system of both groups is at present as good as would be expected in plants of this size, though some of the very small public plants have installed slim and inferior poles and

have used wire which is not up to standard. On the other hand, some of the companies had an unsatisfactory original installation. There is little uniformity in the practice of line inspection. Most of the private plants simply reply, "Constant." Answers from the other group are, "Constant," "Variable," "Very often," "Monthly," "Never."

2. Consumption

Only one municipal plant appears to test customers' meters with any regularity, five out of ten answer, "No," while the remainder say, "When needed," or "On complaint." Five of the companies report regular tests, and regarding the others the writer has no definite information. Complaints are said to be handled with reasonable promptness in most cases.

Practically all of the companies sell appliances, most having show-rooms of some sort in connection with their offices, and a number deal in fixtures. Only the larger public plants do a business of this sort. The usual sale price is at a slight advance over cost.

Special rates to large consumers are made by two or three of the companies, but no such cases were found among the other group. All of the private plants except two report general satisfaction with rates. In two other cases, however, the matter is open to question. Of the municipal plants in only one case was it definitely suggested that the rates are too high. Among the plants here under consideration there has been since 1910 only one petition to the State Board for the reduction of prices, — in one of the companies, — and that was favorably acted upon. But there have been numerous voluntary reductions in both groups, — for the companies, thirteen cases in eight different plants, and for the municipalities, seventeen cases in ten different plants.

In the companies all accounts, so far as ascertained, are collected monthly, as is also the case in all of the larger

public plants. The writer has been indirectly informed, however, that in a number of the smaller municipal plants collections are bi-monthly or even quarterly. In all cases heard from, except one, the payments are made to the managers of the latter group, and not to the town treasurer as is sometimes suggested. It may well be that there are more exceptions of this kind.

3. Financial Considerations

As most of the companies are under central control they have frequent and systematic audits. The municipal plants are audited for the most part annually, usually by the public auditor, the town bearing the charge. In two cases, however, a certified public accountant, paid by the department, does the work, and in one instance the manager himself secures and pays for an outside party.

No important case of free service rendered to the municipality, aside from street lighting, was found, though in two instances a very low special rate is made to the town for power used in pumping water. Other current supplied is customarily paid for at the usual rates. Nor, in the plants from which data have been secured, does any considerable free service seem to be received from other municipal departments. With one exception, no portion of the salary of the town treasurer or the solicitor is paid for. In a few cases public land is used without payment of rental, and in numerous plants, probably in the majority, free offices are enjoyed in the town hall. In at least half of this group of public plants, the town pays for part or all of the insurance carried. The customary policy seems to be to take out a blanket insurance on all public property. Under the circumstances it is hardly worth while to attempt an estimate of the value of the free service received, for it would certainly not amount to more than a few thousand dollars, provided the services frequently contributed by the manager be not included.

None of the municipal plants are carrying any dead investment worth mentioning. But ten of the eleven companies which formerly generated current have amounts ranging in different cases from $1,000 to perhaps $70,000 invested in equipment or real estate which are now, and probably always will be, either useless or at least wholly unnecessary for the successful conduct of their business. The total amount thus carried is approximately between $175,000 and $200,000.

With two or three exceptions in either case there does not appear to have been serious waste or extravagance in investment or operation, while the financial policy has doubtless been reasonably liberal in the majority of cases. Nothing is spent by any of the municipal plants for advertising or getting new business, and a comparatively small amount by the companies.

The accounts of the small public plants are extremely simple, and the opportunities for dishonesty are practically *nil*. In spite of the requirements of the State law,[1] according to the returns of 1915 there were six managers not under bond.

4. The Management

The municipal light boards in a majority of the cases under consideration may be characterized as non-partisan, for no one ever seems to think of the political affiliations of the members. In two plants there is no board, and in several cases the manager is one of the members. In few instances is there any technical knowledge represented on the board.

The manager is ordinarily appointed for a term of one year, but in most cases the tenure is in reality indefinite. A number have been with their plant since its installation. There does not seem to be any fixed basis for selecting a manager. While some suggest "ability" or "fitness

[1] Mass., 1914, ch. 742, sect. 113.

for the work" as a criterion, others are apparently glad to secure the services of any citizen who is willing to do the work cheaply or even without compensation.

One manager was discovered who is a technical graduate. The others have had a varied preparation, the answers to this question being, "No preparation," "Trained in the plant," "Business college," "Private study of electricity," "Training in a private plant," etc. So far as could be discovered there is only one manager of these municipal plants who belongs to a technical society, and the numbers among the companies are very few.

The municipal managers of lighting are usually given a free hand so far as the actual operation of the plant goes; but they are carefully restricted by the municipal board in the purchasing of material. Only a few cases of probable dishonesty were found, and politics seem as a general thing to have been conspicuous by reason of their absence.

As might be expected, the general run of managers of this group of public plants are men of small caliber, though there are a number of outstanding exceptions. As indicated by letters to the writer and to the Board of Gas and Electric Light Commissioners, many are wholly untrained either for business or for anything else. Yet, due to the patient attention and assistance which has been given them by the State, they have managed to correct many of their earlier mistakes, so that now they get on reasonably well. In only four cases do the managers of municipal plants devote all of their time to the lighting department, while practically all of the managers of private plants must of necessity do so. Hence, it is not to be wondered at that the operating expenses of the companies tend to be relatively higher than those of the other group, which frequently pay nothing at all for management.

5. The Employees

In the average plant of the present group so few laborers are employed that it hardly seems worth while to devote any time to a discussion of this part of the schedule, for few of the questions really apply. In many instances, particularly in the public plants, the manager is the factotum, performing all the work that needs to be done in his spare time. Most of the other employees of the municipal plants, at any rate, are little more than ordinary day laborers, and the wages paid are correspondingly low. In most cases they work only part time. Occasionally the services of employees of other municipal departments are utilized, as it is otherwise difficult to secure help when needed.

In the majority of cases the usual working day is eight hours, though the question of the time worked is not of much consequence on account of the fragmentary character of the work. While in many cases the ordinary holidays are allowed with pay, and frequently vacations are granted, it is not customary for the municipal plants, at any rate, to give pay to employees during periods of sickness.

6. General Considerations

In thirteen cases out of twenty-one in this group the municipalities entered upon the lighting business because there was at the time no electric service in the territory. In some places, to be sure, companies which might have been glad to extend their services were kept out; but for the most part there was little in the situation to attract private enterprise, if five or six of the larger plants be barred. Of other answers gleaned from the survey, to the question regarding the reason for acquiring a plant, the following are suggestive: "To get satisfactory service," "To save money," "To secure good street lighting,"

"Recommended by the investigating committee," "Desire for municipal ownership."

At the present time there appears to be little opposition encountered by either group of plants from the municipal government, the business men, or the citizens in general. Formerly there was some dissatisfaction in two or three cases both for the companies and for the public plants.

As stated in an earlier chapter there is no gas competition in thirteen of the municipal plants, while there is gas in the territory of all but six of the companies. Practically all of the latter make some effort to secure new business, by means of advertising, soliciting, and display of appliances. In no instance did the manager of a municipal plant say that any definite attempt is made to push business, though where gas is present there is some rivalry. In a few cases the territory is already well developed, and usually the new customers seem to come as rapidly as the town is ready to take care of them. As long as the current is purchased, the question of the load factor — which, by the way, is never computed — rarely worries those in charge of municipal plants.

As there are not many industries in the districts served by this group, and as the amount of power supplied by a purchasing plant depends pretty largely upon the conditions at the source of supply, i.e., the selling plant, the question of the discouragement of new enterprises because of lack of facilities is not important. Also, for a similar reason, it can probably be said that the future development of business has been adequately provided for.

The companies suggest little criticism of their present system, and only scattering complaints were received from the municipalities, though probably many of the suggestions made regarding the generating plants would apply here as well. Aside from the negligible cases indicated in a preceding table, there appears to be no notice-

able dissatisfaction with the present state of affairs in either group and no desire for a change of ownership. Each community is either performing or having performed for itself that service which it desires, in a manner which meets with the general approval. No important issues seem to be involved in the case of these small plants other than those which have already been suggested.

Summary

Little that is new can be gleaned from the local survey of these purchasing plants. In many regards there does not seem to be much to choose between the two groups. However, the following facts stand out:

1. The municipal plants now appear to be following in general a more cautious policy in making extensions, and they frequently put a good deal of the cost on the customer.

2. The public plants do not usually sell any appliances, and rarely make any attempts to get new business. Perhaps it has not till now been necessary to do so, though it will be remembered that their power load is much poorer than that of the private plants.

3. The general business and financial policy of the companies, due to the fact that they are centrally controlled, appears in most respects to be more systematic than that of the other group.

4. An appreciable amount of free service is received by the public plants from their municipalities.

5. The large investment in "dead assets" ($175,000 to $200,000) of the companies is for the most part a complete loss, and, from the nature of the case, could not well have been avoided. The public plants, due to their more recent installation, have been more fortunate in this regard.

6. The managers of these municipal plants, four or five of the larger ones excepted, are usually men of small

capacity who give their services to the public for an inadequate compensation, or *gratis*.

7. The labor problem is insignificant, as the manager is frequently the only employee, and he rarely gives all of his time to the work.

8. In most cases the municipalities acquired their plants because otherwise they would have had no electrical service. In a few instances, however, on account of the excellence of the territory, there was probably a hope of financial gain of some kind.

9. Politics seem to have been conspicuously absent in these small public plants; and the two groups of communities, barring one or two places served by companies, seem at present to be well satisfied with that form of ownership which they now chance to have.

10. The comparative success of this group of public plants is due in large measure to the attention given them by the State Board of Gas and Electric Light Commissioners, rather than to their own unaided efforts. The corresponding companies, on the other hand, while they leave much to be desired, have probably been benefited by the systematization which has recently come from "central control"; and, economically, it would no doubt have been better had they never been carried on as separate concerns.

CHAPTER XIV

CONCLUSION

THE chief purpose of this study has been, first, to interpret the data which appear in the annual returns of the two groups of electric plants under consideration, and, secondly, by means of carefully conducted local surveys to test the tentative conclusions reached by the first method as well as to collect additional information of a highly valuable sort not to be found in any written records, — all with a view to ascertaining, as nearly as a scientifically impartial yet wholly sympathetic investigation can reveal, how municipal electric lighting in Massachusetts compares with private enterprise in the same field. It is hoped, however, that the methods of research herein developed and the conclusions thus cautiously arrived at, will be of more than passing value to the great group of thinking men, whether engaged in private business or in the public service, who really take an intelligent interest in the numerous problems of public industry.

While throughout this study the writer has honestly endeavored to keep an open mind on the question, there remains, of course, some slight possibility of error, even when the local background is accurately known. Every attempt, however, has been made to eliminate the disturbing factors, to make reasonable allowances when necessary, and always to keep the data as nearly comparable as circumstances will permit. The intangible items in such a problem as this are somewhat difficult to evaluate, even after they have been discovered. Yet it does not seem probable, in view of the double check that is afforded by the local survey and by the various methods of statistical approach, that the findings herein outlined can be far

wrong. It must also be recalled in this connection that, as was stated in the very beginning of our study, public business has been compared with private business *at its worst* in the State, from which fact the reader is at liberty to draw what inferences he may choose.

Most of the conclusions reached have been from time to time suggested as the several items were under discussion. Accordingly, the reader should be permitted to decide for himself as to whether or not the conditions which have been indicated are such as to make out a clear case for or against municipal ownership in this particular industry. Here, then, may be summed up briefly the results of the present investigation; and it will not be amiss for the writer to make certain suggestions which, as he believes, might with profit be considered by the Massachusetts Board of Gas and Electric Light Commissioners, by other State commissions, and by the municipalities themselves.

In the first place, it appears that the conditions under which the municipal generating plants are operating, both natural and artificial, are far more favorable to success than is the case in the corresponding group of companies. They serve a more densely populated territory, in which relatively more manufacturing is done than in the districts supplied by the other group. Nor does their history indicate that they have in general been instrumental in promoting the higher industrial development here found.

When the pragmatic test is applied, it becomes evident that, from the physical, financial, and developmental point of view, when due allowances have been made, this group of public plants (Holyoke excepted), have, in the more important respects, usually lagged somewhat behind the private plants studied. They seem not to be serving their more favorable territory so adequately as are the latter, nor have they made any attempt to develop new territory. They have probably tended to be too conservative in their

extension policy, and, with a very few exceptions, have taken little thought regarding the future development of business, in so far as their station equipment is concerned. Their aim seems to have been to follow rather than to lead the growth of industry and the new demands for service. This, however, may be a far more correct policy for a public industry to pursue than one of reckless expansion which sometimes characterizes the conduct of private enterprise.

In a financial way they have recently, for the most part, been doing reasonably well — a condition of affairs due to over-conservatism rather than to superior efficiency. The operating accounts and balance sheets make a much better showing for municipal ownership than do the physical features of the business, which are not so easily discovered, but which, when properly studied, furnish us with far more accurate tests than can be applied by means of a superficial survey of rates and balance sheets. Though the earlier deficits are generally being made good, the quality of the service rendered has, in many cases, appeared to suffer as a result.

Upon the whole, while this group of plants have by no means been altogether failures, it cannot be truthfully asserted that, when all elements in the problem are considered, they have been any conspicuous success. With one or two exceptions they seem simply to be performing for themselves, with little or no return except the satisfaction derived from their exertions, those services which might have been rendered equally well, if not better, by private enterprise.

Fortunately these municipal plants have been in the main comparatively free from most of the sinister influences which frequently beset public business of this kind. Yet, barring Holyoke, careful investigation has revealed the fact that the larger the city having its own plant, the greater is the danger from "politics" and "graft." In at

least one unusually important case the conditions have been disgusting beyond belief; while in two other large plants, in the past at any rate, the situation has been, to say the least, highly unpleasant.

Nor is the outlook a propitious one. Not a municipal generating plant has been installed since 1904, though eighteen purchasing plants have begun operation since 1907. There is a marked tendency in both groups in favor of purchasing current from large private concerns and doing only a distributing business. Already three of the companies studied for the year 1914–15 have ceased the generation of current; but within the same time *seven* municipal plants have for the present, and probably for all time, stopped the production of current. And, in spite of the great loss which will result to the community if a public plant be "scrapped," and notwithstanding the greatly increased cost of street lighting which must be borne, it would probably be far more economical in many cases to follow this policy than to overhaul the old plants and equip them for future needs.

In some respects a marked contrast is afforded by the municipal plants which operate only a distributing system. For them, the conditions seem to be in large measure reversed. They have, in many instances, commenced operation in districts which could offer small inducement to private concerns, and it might appear that they would accordingly have little possibility of success. Yet, as a result of the united public sentiment back of them, and by reason of the careful supervision of the Board in countless details, they have made an unusually good showing as contrasted with the purchasing companies.

As would naturally be the case by reason of their more recent installation, this group of public plants is burdened with a far lower investment than are the private plants. As they have never generated any current, they have had no opportunity to accumulate a larger proportion of "dead

assets." In fact, the relations existing between the two, in this regard, are such that it seems almost futile to attempt comparisons. But, measured by the tests which it is customary to apply, they appear to have been making a better record, under less favorable geographical and business conditions, than have the other plants. To be sure, they have not really made anything in a financial way — they have, upon the whole, simply kept even with the game. They are still young, and in the years to come, when repairs and renewals become urgent, the operating expenses can be expected to mount rapidly. A good share of their success also is due to the fact that they are dependent upon private enterprise for that portion of the business which is most difficult to be handled by public officials and employees. All credit is due them, however, inasmuch as they have been rendering, at a comparatively low cost, service which would in many cases have been difficult if not impossible to secure from private concerns.

Finally, the writer believes that, under such effective regulation of the electric light and power business as is found in Massachusetts at present, there is no reason whatever why a municipality should invest in an electric plant, certainly not in a generating plant. No real economies are likely to be thereby effected, and the possibility of loss is great. There may be instances in which public ownership of merely a distributing system is highly desirable. Yet, this form of ownership, also, from an economic point of view, is justified only when private business cannot be induced to enter the field except at prohibitive rates. The day has long passed when there is no alternative between unrestricted private industry, on the one hand, and public ownership on the other. There now seems to be no valid reason for using the taxpayers' money for the sake of doing what can be as well done without adding to the ever-increasing municipal debt. The burden of proof clearly rests upon those who would, under the cir-

cumstances, advocate a further municipalization of the industry in this State.

To be sure, there is another side to the problem, which must not be overlooked. While it may not be desirable as a general policy for municipalities to acquire their own plants, it is certainly beneficial for all concerned to have a State law *enabling* them to do so if they choose. The *possibility* of public ownership frequently "puts the fear of God" in the hearts of those who might otherwise at times forget that a public utility enjoys a certain monopoly advantage, granted *by the people*, and for which, accordingly, it owes much *to the people* in return. Furthermore, a few examples of even reasonably successful public ownership may act somewhat as a spur to those in private business, causing them to put forth more effort to live up to their opportunities. Hence, while public ownership might be a questionable experiment to attempt on a larger scale, and while it has doubtless been, in many cases, wholly unnecessary in this State, yet the fact that both kinds of ownership have existed side by side in the past, has probably been of considerable value to both public and private business. And, at any rate, the study of the situation in this State has afforded unusually valuable data, which may serve as a guide to those who in the future wish to municipalize or nationalize our public utilities.

No attempt is made at this point to draw any conclusions regarding the private plants in the State, for two reasons: first, those companies studied are scarcely large enough to be typical of private electric light and power business in Massachusetts, and, secondly, this is meant to be a study of *municipal ownership* and *not* of private enterprise. From the data which have been collected, presented, and discussed without prejudice, it is preferable for the reader to make his own judgments.

It is fairly obvious, however, that, upon the whole, the

larger companies studied, though they are often far from ideal, have made a considerably better showing than have the municipal plants. While there may have been some mismanagement and even exploitation in the past in one or two cases, there seems to be little real ground for complaint at present. It is also an open question whether the recent agitation by the Commissioners against the increasing central control of lighting companies, is now wholly justified by the facts, unless in the case of the purchasing plants. While there are doubtless exceptions, it may well be that the increased skill in operating, together with the superior guidance and more effective bargaining power which are thus secured, far outweighs the additional financial burdens which such a policy entails. Frequently, also, the customary regulation may have induced horizontal combination in self-defense. At any rate, the writer's investigations have led him to believe that, at present, the public can in general hope for more ready and intelligent service from the plants under group control, *properly regulated*, than from those independently owned and operated. This observation, however, is not in any sense intended to be more than a tentative conclusion on the matter, for it is not here possible to make a detailed analysis of all of the factors involved.

In conclusion, it is not unfitting for the writer to make a few suggestions as to the policy which, in the light of this investigation, it appears might be profitably pursued in the future with respect to the conduct of municipal electric lighting plants in the State. Two significant considerations present themselves, the first relating more directly to the returns required by the Board, and the second having to do largely with the municipalities themselves and with the laws relating thereto.

In the first place, the returns should be made more definite. The Commissioners should prescribe exactly what information is to be given in such a way that misunder-

standings will be reduced to a minimum. Too frequently the inaccuracies which have constantly annoyed the writer have resulted from vagueness in the requirements, for which the reporting plant should not be held responsible.

There should also be a more careful separation of some of the items in the returns, particularly in the case of outlays for labor and materials which appear in the expense accounts. The companies as well as the public plants should be required to return the wages which they pay, together with the usual hours of labor. More attention should also be paid to an analysis of some of the simpler engineering features of the business, and the generating plants especially should be required to make more provision for the accuracy of their records.

A *really* uniform policy should be adopted regarding the capital accounts that are to be kept by the municipal plants, and the data should be so presented that valid comparisons can be made of the investment in the two groups. *This* amount should be published, instead of the incomparable, artificially depreciated "plant accounts" as at present given in the Annual Report. New construction, from whatever source the funds may have been derived, should be treated as such in the returns.

All plants, both public and private, should be required to work out the more important relations between their individual data, physical and financial. From such a policy a twofold gain would result. In the first place, it would have a wholesome effect upon the plants themselves, as their attention would thus be directed to many vital problems which are now overlooked; and in the second place, based on the information thus available, the Board might well incorporate in their Annual Report a few of the figures which would make it possible for an intelligent student of problems such as these to find out the more significant relations existing between the two classes of plants, without being compelled to wade through a mass

of undigested and uncorrelated material in the separate returns.

While all praise is due the Board for the effectiveness with which they have regulated the industry under discussion, and while even greater credit should be given them when we know how "under-staffed" they have at times been for the performance of so important a work as they have to do, yet it does appear that their system of accounting has developed in a somewhat haphazard fashion — due to the impossibility, in many instances, of securing from the managers of municipal plants any usable records whatever. In the returns, perhaps the merely financial aspects of the problem have been over-emphasized, while some of the more fundamental elements in the case have been lightly stressed. To be sure, there is the danger of losing sight of the underlying principles as a result of giving too much attention to the statistical and accounting features of public regulation. When, however, such studies may throw light on these larger problems, the effort so expended is not in vain.

Finally, and far more important from an economic point of view, the municipal plants should be required, by law if necessary, to be conducted *exactly as if they were commercial enterprises*. In no other way can the public be made to understand clearly what they are gaining or losing as a result of municipal ownership. Only by subjecting these publicly owned plants to the same tests that are applied to private business can we reach any definite conclusions as to their real efficiency.

This means that they should sell street lighting service to their municipalities at what appears to be a fair price, and that they should in turn pay taxes at the usual rate.[1]

[1] Every manager of an important plant has agreed with the writer that it would be conducive to the best interests of all if the street lighting were put on a strictly commercial basis. Several have also assented to the proposition that taxes should be paid, when it was carefully explained to them.

They should either own all of their property, or, if municipal real estate be utilized, they should pay an equitable rental therefor. Further, the services rendered by any public official should be estimated and charged at the true value of that service. Probably not a single appropriation should be made from the tax levy for any purpose whatever in connection with a municipalized commercial enterprise, after it has become "seasoned." Such an industry should be given every opportunity that is afforded to private business, and it would, in addition, have the advantage of securing its capital at a lower than usual rate of interest. But here the public financial responsibility should end.

If publicly owned commercial business were carried on as here suggested, the writer will venture to predict that, while many municipalities would be dissuaded from plunging into ills that they know not of, those which have already acquired an industry or which, under the new conditions, *do* make the experiment, will be encouraged to bring their business to the highest degree of efficiency. Whatever may be our conclusions regarding the desirability of public ownership for other than financial reasons, there seems to the writer to be no disputing the fact that if the attempt *is* made, it should be done in the most effective manner possible. Whether under private ownership or under public control, there probably *never has been* and *never will be* a time when the best results can be attained if those methods which make for efficiency, those stimuli to individual initiative which are the basis of industrial and social development, are cast into the discard. From an economic point of view, the more nearly public business conforms to the well-known canons of the *best* private enterprise, the more successful it is bound to be.

In parting, what further light does the present study throw upon the broader problems of public ownership?

The stress of the present war is greatly hastening a tendency which was already strongly pronounced in the electric light and power business throughout the country, i.e., the shutting-down of small and wasteful generating plants, and the consequent development of a comparatively few large central stations — hydro-electric wherever possible — which can keep pace with the economic growth of the industry, and thereby conserve for other uses our supplies of fuel. The electrification of practically all means of transportation is probably not far distant; the use of electric current will eventually, no doubt, displace other methods of heating; our factories will depend for motive power almost solely upon central station generation. We are on the threshold of marvelous possibilities in the art.

But in the meantime much experimentation will be necessary, great risks must be run, many failures will ensue. The problem is fundamentally too vast to be bounded by the confines of any municipality, with its petty demagoguery and the jealousy of its neighbors. No unit smaller than the State could possibly deal with the situation.[1] But would the State prove equal to the task? We fear not, so long as human nature remains as it now is. Under democratic institutions, the larger the governmental body, the less economic and the more political it becomes, and the more energy is wasted in accomplishing little. To blaze the trail is the work of a select few, not of the people *en masse*. The electrical industry, as *all* industries which reach their perfection, will be developed by personal genius and individual effort, urged on by the desire to serve, no doubt, but more potently stimulated by the prospect of material rewards.

What part the State and the National Government

[1] There is at present a bill before Congress to provide for the permanent development by the Federal Government of the hydro-electric resources of the country. Some States also have discussed similar measures.

will play in our future industrial life, cannot well be foretold. The more primitive stages of civilization were marked by minute regulation of private affairs. The individual was submerged, while the ruler, or his representatives, was the chief entrepreneur. Such an extension of state activity to commercial undertakings does not appear to be compatible with freedom and growth. The *most autocratic* of civilized governments has until recently also been the most active in industrial enterprises. Could it be otherwise? The present world struggle is forcing others to follow suit. Will the coming of peace bring with it a fuller realization of the dreams of the socialist, or will the former conditions be restored? Public ownership of some producers' goods may eventually become more general. We must not, however, be unmindful of the fact that, when the war is over, people will again be actuated by the old individual motives; most of the existing urgent incentives to unselfish group action will cease. Business now carried to a reasonable degree of perfection by the public powers, will, if retained in public hands, be in danger of rapid stagnation. Whatever the sequel may be, this modest study, as well as most careful and unbiased investigations, points to the conclusion that as a rule only the simplest and the "well-seasoned" enterprises are at all suitable for public operation; and even these are in grave danger of becoming less efficient than they would be in private hands. Though political expediency or social necessity may sometimes momentarily outweigh all economic considerations, it still seems inherent in the nature of things that private industry must continue to show the way.

BIBLIOGRAPHY

NOTE

THE purpose of this bibliography is to show what sort of material is available for a study of this kind, and to indicate some of the sources of information which the author has found it either necessary or desirable to look into. Few of the references specifically on the subject of public ownership have been of any direct benefit, though sometimes very useful suggestions have been discovered buried in a mass of trash. The sources which have proved most helpful have been clearly mentioned in the text. In addition, many letters and private documents have been of some value. In practically all respects, however, this study has necessarily been carried on along wholly independent lines, as it is built up out of the raw material.

Frequently the publications here listed have been referred to in an abbreviated form in the text. Whenever such reference might lead to confusion, the abbreviation is given after the entry. Titles are usually listed according to the author's name or according to political subdivisions.

For the convenience of the reader the following classification has been made: —

1. *Books and manuals;*
2. *Public documents and bulletins (national, state, and municipal), laws, and official reports;*
3. *Articles in periodicals; transactions and proceedings of technical societies;*
4. *Monographs, bulletins, miscellaneous reports, addresses, etc.*

CLASSIFIED LIST OF REFERENCES

I. BOOKS AND MANUALS

American Handbook for Electrical Engineers. Edited by Harold Pender. New York, John Wiley & Sons, 1914; pp. 2023.

Avebury, Rt. Hon. Lord, P.C. (John Lubbock).
On Municipal and National Trading. London, Macmillan & Co., 1907; pp. 178.

Barker, Harry.
Public Utility Rates. New York, McGraw-Hill Book Co., 1917. pp. xiv, 387.

Barrows, William Edwards, Jr.
Electrical Illuminating Engineering. New York, McGraw Publishing Co., 1908; pp. v, 216.

Bemis, Edward W., editor.
Municipal Monopolies. New York, Thomas Y. Crowell & Co., 1899; pp. 691. ("Mun. Monop.")
Buckley, William Joy.
Electric Lighting Plants: Their Cost and Operation. Chicago, 1894; pp. 275, 32 ill., 20 pl.
Central Stations, List of, in United States, Canada, and Mexcio. New York, McGraw-Hill Book Co., 1916. ("McGraw Electrical Directory"; published semi-annually.)
Cleveland, Frederick A.
Municipal Administration and Accounting. New York, Longmans, Green & Co., 1909; pp. xvi, 361.
Cole, William Morse.
Accounts: Their Construction and Interpretation. Boston, Houghton Mifflin Co., 1908; pp. 345.
Cushing, H. C., and Harrison, Newton.
Central Station Management. New York, D. Van Nostrand Co., 1916; pp. 397.
Darwin, Leonard.
Municipal Ownership. (Four lectures delivered at Harvard University.) New York, E. P. Dutton & Co., 1907; pp. 149.
Darwin, Leonard.
Municipal Trade: The Advantages and Disadvantages. New York, E. P. Dutton & Co., 1903; pp. 464.
Davies, Emil.
The Collectivist State in the Making. London, G. Bell & Sons, 1914; pp. 267.
Dawson, William H.
Municipal Life and Government in Germany. New York, Longmans, Green & Co., 1914; pp. 507. (Cf. ch. IX, pp. 209–259, "Trading Enterprises.")
Edwards, H. M.
Electric Light Accounts and Their Significance. New York, McGraw-Hill Book Co., 1914; pp. 172.
Electrical Meterman's Handbook. 3d ed. National Electric Light Association. New York, 1912; pp. 1076.
Fairlie, John A.
Essays in Municipal Administration. New York, 1908; pp. 374.
Floy, Henry.
The Colorado Springs Lighting Controversy. New York, The Illuminating Engineering Publishing Co., 1908; pp. 327.
Foster, Horatio A.
Engineering Valuation of Public Utilities and Factories. New York, D. Van Nostrand Co., 1912; pp. 345.
Francisco, M. J.
Municipal Ownership *vs.* Private Corporations. 5th (?) ed. Rutland, Vt., M. J. Francisco & Son, 1898; pp. 150. (Statistics to date.)

Garcke, Emile.
Manual of Electrical Undertakings. London, 1896 to date. (Published annually.)
Gear, Harry Barnes, and Williams, Paul Francis.
Electrical Central Station Distribution Systems. 2d ed. New York, D. Van Nostrand Co., 1916; pp. 457.
Gessell, Gerhard A.
Minnesota Public Utility Rates. Current Problems, No. 3. Bulletin of the University of Minnesota. Minneapolis, 1914; pp. 254.
Grunsky, Carl Ewald, and Grunsky, Carl Ewald, Jr.
Valuation, Depreciation, and the Rate-Base. New York, John Wiley & Sons, 1917; pp. 387.
Guyot, Yves.
Where and Why Public Ownership Has Failed. Tr. by H. F. Baker. New York, Macmillan Co., 1914; pp. 459.
Hayes, Hammond V.
Public Utilities: Their Cost New and Depreciation. New York, D. Van Nostrand Co., 1913; pp. 262.
Hayes, Hammond V.
Public Utilities: Their Fair Present Value and Return. New York, D. Van Nostrand Co., 1915; pp. 207.
Holmes, F. L.
Regulation of Railroads and Public Utilities in Wisconsin. New York, D. Appleton & Co., 1915; pp. 375.
Howe, F. C.
The British City. New York, Scribner's, 1907; pp. 370. (Cf. ch. IX, especially.)
Jansky, Cyril M.
Electrical Meters. New York, McGraw-Hill Book Co., 1913; pp. 370.
Jevons, W. Stanley.
The State in Relation to Labor. London, Macmillan & Co., 1894; pp. XXIX, 171.
Johnson, George.
Electric Lighting Accounts. (Accountants' Library, vol. 29.) London, Gee & Co., 1904; pp. xv, 128.
King, Clyde Lyndon, editor.
The Regulation of Municipal Utilities. New York and London, D. Appleton Co., 1912; pp. ix, 404. (National Municipal League Series.)
Knoop, Douglas.
Principles and Methods of Municipal Trading. London, Macmillan & Co., 1912; pp. xvii, 409.
Knox, Charles E., and Shaad, George E.
Electric Wiring and Lighting. Chicago, American Technical Society, 1915; pp. 87, 94, vi.
Kommunales Jahrbuch. Jena, G. Fischer, 1908 to date.

Marks, William D.
The Finances of Gas and Electric Light and Power Industries. New York, 1907; pp. 540 and 27.

Marks, William Dennis.
Practical Rate Making and Appraisement. New York, Lyons Printing Co., 1914; pp. 269, diagrams.

Matthews, Nathan.
Municipal Charters. Cambridge, Harvard University Press, 1914; pp. 210.

Meyer, H. R.
Municipal Ownership in Great Britain. New York, Macmillan Co., 1906; pp. 340. (Cf. chs. XII–XVIII.)

Moody's Analyses of Investments. Part II. Public Utilities and Industrials. (Published annually.)

Morgan, Joy E., and Bullock, Edna D.
Selected Articles on Municipal Ownership. Minneapolis, The H. W. Wilson Co., 1911; pp. 219.

Municipal Accounting. Handbook of New York Bureau of Municipal Research. New York, D. Appleton & Co., 1913; pp. 318.

Municipal Monopolies. Edited by Bemis. New York, Thomas Y. Crowell & Co., 1899; pp. 691. ("Mun. Monop.")

Municipal Year Book. London, Municipal Journal, 1897 to date. (Cf. vol. XVIII, 1914, pp. 673–729; lists of accounts, pp. 1087–1090.)

Munro, William Bennett.
Principles and Methods of Municipal Administration. New York, Macmillan Co., 1916; pp. 491. (Cf. ch. X, "Municipal Finance.")

National Civic Federation.
Commission Regulation of Public Utilities. New York, 1913; pp. 1284. (Analyses of Public Utility Laws of 43 States, and of Federal Government.)

National Civic Federation.
Report. Municipal and Private Operation of Public Utilities. 3 vols. New York, 1907; pp. 489, 1230, 768.

National Electric Light Association.
Standard Classification of Accounts. New York, The James Kempster Printing Co., 1914; pp. 115.

Parsons, Frank.
The City for the People. Philadelphia, C. W. Taylor, 1901; pp. 704.

Poor's Manual of Public Utilities. New York, 1913, to date. (Published annually.)

Porter, Robert P.
The Dangers of Municipal Ownership. New York, Century Co., 1907; pp. 356. (Cf. particularly ch. XIII.)

Public Utility Economics.
A Series of Ten Lectures Delivered before the West Side Young Men's Christian Association. New York, The Finance Forum, 1914; pp. 195.

Pond, Oscar Lewis.
Municipal Control of Public Utilities. Ph.D. Thesis, Columbia University, 1906; pp. 117.
Raymond, William L.
American and Foreign Investment Bonds. Boston, Houghton Mifflin Co., 1916; pp. 324. (Cf. ch. VI.)
Saliers, Earl A.
Principles of Depreciation. New York, The Ronald Press, 1915; pp. 200.
Seabrook, A. Hugh.
The Management of Public Electricity Supply Undertakings. New York, McGraw-Hill Book Co., 1913; pp. 192, xx.
Shaw, Bernard.
The Common Sense of Municipal Trading. London, A. C. Fifield, 1908; pp. 120. (Fabian Socialist Series, No. 5.)
Whinery, S.
Municipal Public Works. New York, Macmillan Co., 1903; pp. 241. (Cf. chs. XIII–XIV.)
Whitten, R. H.
Valuation of Public Service Corporations. New York, Banks Law Publishing Co., 1912; pp. 798. (Cf. ch. XXXII, pp. 721–745, "Bibliography of Valuation and Depreciation.")
—— Supplement to above. New York, 1914; pp. 799–1443.
Wilcox, Delos F.
The American City: a Problem in Democracy. New York, Macmillan Co., 1904; pp. 423. The Citizen's Library. ("The Control of Public Utilities," pp. 52–90.)
Wilcox, Delos F.
Municipal Franchises. Vol. I, pp. 710. Rochester, N.Y., The Gervaise Press, 1910. Vol. II, pp. 885. New York, The Engineering News, 1911.
Williams, Arthur, and Tweedy, Edmund F.
Commercial Engineering for Central Stations. New York, McGraw-Hill Book Co., 1912; pp. 142.
Wyer, Samuel S.
Regulation, Valuation, and Depreciation of Public Utilities. Columbus, Sears & Simpson Co., 1913; pp. 313.
Zueblin, Charles.
American Municipal Progress. (Rev. Ed.) New York, Macmillan Co., 1916; pp. 522.

II. Public Documents and Bulletins (National, State, and Municipal), Laws, and Official Reports

Adams, Alton D.
Municipal Electric Plants in Massachusetts. Testimony before the United States Industrial Commission. Washington, 1901. Reports, vol. IX, pp. 275–285.

Cleveland.
The Cleveland Municipal Lighting Plant. Bulletin No. 1, April, 1915; pp. 26. Bulletin No. 2, September, 1915; pp. 96.
Light Plant Audit for 1915, in the City Record, March 7, 1917; pp. 3–28 (253–278).

Connecticut. Bureau of Labor Statistics.
15th Annual Report, 1899. Hartford, 1899; pp. 15–88. (Private and Municipal Ownership. 1. Electric Light and Power Plants. 2. Gas Works. 3. Water Works.)

Holyoke Water Power Company *v.* City of Holyoke, vol. XVI.
Brief for the Respondent; by Nathan Matthews, Jr., Addison L. Green, of Counsel; Nathan P. Avery (City Solicitor). Submitted Dec. 26, 1901. Boston, 1902; pp. 526.

Indiana. Bureau of Statistics.
Electric Light and Power, Gas and Water Plants of Indiana. Indianapolis, 1899; pp. 41.

Kansas. Bureau of Labor and Industrial Statistics.
13th Annual Report, 1897. Topeka, 1898; pp. 91–98. (Water, Electric Light, and Gas Plants.)

Maltbie, M. R.
The Indeterminate Franchise for Public Utilities, or Tenure during Good Behavior. Annual Report, New York Public Service Commission, First District, 1908, vol. I, Appendix A (pp. 175–208).

Massachusetts.
Aggregates of Polls, Property, Taxes, etc. Public Document No. 19. Compiled in Office of Tax Commissioner. Boston. (Published annually.)

Massachusetts. Board of Gas and Electric Light Commissioners.
Annual Reports. 1886 to date. ("Mass. G. & E.")

Massachusetts. Board of Gas and Electric Light Commissioners.
The Annual Returns of practically all electric plants in the State have been used for the years, 1905–1915, inclusive.

Massachusetts. Board of Harbor and Land Commissioners.
Annual Report for 1915. Area of Counties, Cities, and Towns of Massachusetts, as of Nov. 30, 1915. (Reprint, pp. 7.)

Massachusetts. Bureau of Labor Statistics.
Census of 1905. Part IV : Agriculture, the Fisheries, and Commerce. Boston, 1909; pp. 598.

Massachusetts. Bureau of Statistics.
Twenty-ninth Annual Report of the Statistics of Manufacture for the Year 1914. Public Document, No. 36. Boston, 1916; pp. liii, 114.

Massachusetts. Bureau of Statistics.
Annual Report of the Statistics of Municipal Finances. Public Document, No 79. Boston, 1911 to date.

Massachusetts. Bureau of Statistics.
Sixth Annual Report on Union Scale of Wages and Hours of Labor in Massachusetts (1915). Labor Bulletin, No 114. Boston, 1916; pp. 103.

Massachusetts. Bureau of Statistics.
A Uniform Classification of Municipal Receipts and Expenditures. Municipal Bulletin, No. 1. Boston, 1910; pp. 64.
Massachusetts. Bureau of Statistics.
The Issue and Certification of Town Notes. Municipal Bulletin, No. 3. Boston, 1911; pp. 11.
Massachusetts. Bureau of Statistics.
Laws Relating to Municipal Finances. Municipal Bulletin, No. 7. Boston, 1915; pp. 49.
Massachusetts. Bureau of Statistics.
Report of the Special Investigation Relative to the Indebtedness of the Cities and Towns of the Commonwealth. Boston, 1912; pp. 286.
Massachusetts. Bureau of Statistics.
Report of the Special Investigation Relative to the Sinking Funds and Serial Loans of the Cities and Towns of the Commonwealth. Boston, 1913; pp. 25.
Massachusetts. Bureau of Statistics.
Return of the Director of the Bureau of Statistics of the Number of Inhabitants and Legal Voters as Determined by the Decennial Census of 1915. House Document, No. 1169. Boston, 1916; pp. 18.
Massachusetts. Highway Commission.
Twenty-second Annual Report. (For fiscal year ending November 30, 1914.) Boston, 1915; pp. 206.
Massachusetts. Laws.
Acts and Resolves. 1885–1914. Particularly ch. 742 of the Acts of 1914.
General Acts. 1915–1917.
Special Acts. 1915–1917.
Revised Laws of 1902; cf. chiefly: —
Ch. 34. "Of the Manufacture and Distribution of Gas and Electricity by Cities and Towns."
Ch. 110. "Of Manufacturing and Other Corporations."
Ch. 121. "Of Gas and Electric Light Companies."
Supplement to the Revised Laws, 1902–1908.
Massachusetts. State Forester.
The Forests of Worcester County. 1916. Boston, 1917; pp. 88.
Massachusetts. State Tax Commissioner.
Annual Reports since 1890. Boston.
Michigan. Bureau of Labor and Industrial Statistics.
15th Annual Report. Lansing, 1898; pp. 183–198. (Statistics of Electric Lighting, Gas, and Water Plants in Michigan.)
Municipalities owning electric lighting plants. The Annual Reports of public plants both in Massachusetts and in other States have been referred to.
Nebraska. Bureau of Labor and Industrial Statistics.
Sixth Biennial Report. 1897–98. Lincoln, 1898; pp. 366–371. (Private and Municipal Ownership of Waterworks, Electric Light and Power Plants, and Gas Works.)

Cleveland.
The Cleveland Municipal Lighting Plant. Bulletin No. 1, April, 1915; pp. 26. Bulletin No. 2, September, 1915; pp. 96.
Light Plant Audit for 1915, in the City Record, March 7, 1917; pp. 3–28 (253–278).

Connecticut. Bureau of Labor Statistics.
15th Annual Report, 1899. Hartford, 1899; pp. 15–88. (Private and Municipal Ownership. 1. Electric Light and Power Plants. 2. Gas Works. 3. Water Works.)

Holyoke Water Power Company *v.* City of Holyoke, vol. XVI.
Brief for the Respondent; by Nathan Matthews, Jr., Addison L. Green, of Counsel; Nathan P. Avery (City Solicitor). Submitted Dec. 26, 1901. Boston, 1902; pp. 526.

Indiana. Bureau of Statistics.
Electric Light and Power, Gas and Water Plants of Indiana. Indianapolis, 1899; pp. 41.

Kansas. Bureau of Labor and Industrial Statistics.
13th Annual Report, 1897. Topeka, 1898; pp. 91–98. (Water, Electric Light, and Gas Plants.)

Maltbie, M. R.
The Indeterminate Franchise for Public Utilities, or Tenure during Good Behavior. Annual Report, New York Public Service Commission, First District, 1908, vol. I, Appendix A (pp. 175–208).

Massachusetts.
Aggregates of Polls, Property, Taxes, etc. Public Document No. 19. Compiled in Office of Tax Commissioner. Boston. (Published annually.)

Massachusetts. Board of Gas and Electric Light Commissioners.
Annual Reports. 1886 to date. ("Mass. G. & E.")

Massachusetts. Board of Gas and Electric Light Commissioners.
The Annual Returns of practically all electric plants in the State have been used for the years, 1905–1915, inclusive.

Massachusetts. Board of Harbor and Land Commissioners.
Annual Report for 1915. Area of Counties, Cities, and Towns of Massachusetts, as of Nov. 30, 1915. (Reprint, pp. 7.)

Massachusetts. Bureau of Labor Statistics.
Census of 1905. Part IV : Agriculture, the Fisheries, and Commerce. Boston, 1909; pp. 598.

Massachusetts. Bureau of Statistics.
Twenty-ninth Annual Report of the Statistics of Manufacture for the Year 1914. Public Document, No. 36. Boston, 1916; pp. liii, 114.

Massachusetts. Bureau of Statistics.
Annual Report of the Statistics of Municipal Finances. Public Document, No 79. Boston, 1911 to date.

Massachusetts. Bureau of Statistics.
Sixth Annual Report on Union Scale of Wages and Hours of Labor in Massachusetts (1915). Labor Bulletin, No 114. Boston, 1916; pp. 103.

Massachusetts. Bureau of Statistics.
A Uniform Classification of Municipal Receipts and Expenditures. Municipal Bulletin, No. 1. Boston, 1910; pp. 64.
Massachusetts. Bureau of Statistics.
The Issue and Certification of Town Notes. Municipal Bulletin, No. 3. Boston, 1911; pp. 11.
Massachusetts. Bureau of Statistics.
Laws Relating to Municipal Finances. Municipal Bulletin, No. 7. Boston, 1915; pp. 49.
Massachusetts. Bureau of Statistics.
Report of the Special Investigation Relative to the Indebtedness of the Cities and Towns of the Commonwealth. Boston, 1912; pp. 286.
Massachusetts. Bureau of Statistics.
Report of the Special Investigation Relative to the Sinking Funds and Serial Loans of the Cities and Towns of the Commonwealth. Boston, 1913; pp. 25.
Massachusetts. Bureau of Statistics.
Return of the Director of the Bureau of Statistics of the Number of Inhabitants and Legal Voters as Determined by the Decennial Census of 1915. House Document, No. 1169. Boston, 1916; pp. 18.
Massachusetts. Highway Commission.
Twenty-second Annual Report. (For fiscal year ending November 30, 1914.) Boston, 1915; pp. 206.
Massachusetts. Laws.
Acts and Resolves. 1885–1914. Particularly ch. 742 of the Acts of 1914.
General Acts. 1915–1917.
Special Acts. 1915–1917.
Revised Laws of 1902; cf. chiefly: —
Ch. 34. "Of the Manufacture and Distribution of Gas and Electricity by Cities and Towns."
Ch. 110. "Of Manufacturing and Other Corporations."
Ch. 121. "Of Gas and Electric Light Companies."
Supplement to the Revised Laws, 1902–1908.
Massachusetts. State Forester.
The Forests of Worcester County. 1916. Boston, 1917; pp. 88.
Massachusetts. State Tax Commissioner.
Annual Reports since 1890. Boston.
Michigan. Bureau of Labor and Industrial Statistics.
15th Annual Report. Lansing, 1898; pp. 183–198. (Statistics of Electric Lighting, Gas, and Water Plants in Michigan.)
Municipalities owning electric lighting plants. The Annual Reports of public plants both in Massachusetts and in other States have been referred to.
Nebraska. Bureau of Labor and Industrial Statistics.
Sixth Biennial Report. 1897–98. Lincoln, 1898; pp. 366–371. (Private and Municipal Ownership of Waterworks, Electric Light and Power Plants, and Gas Works.)

New York. Bureau of Labor Statistics.
Fifteenth Annual Report. 1897. New York and Albany, 1898; pp. 497–601. (The Ownership and Operation of Electric Light and Power, Gas and Water Plants.)

New York. Public Service Commission of the First District.
Annual Reports, 1907 to date. (Cf. particularly vol. III.)

New York. Public Service Commission of the Second District.
Annual Reports, 1907 to date. (Cf. particularly vol. III.)

New York. Public Service Commission of the First District.
Uniform System of Accounts for Electrical Corporations as Prescribed by the Public Service Commission for the First District. New York, 1914; pp. 68.

Pasadena.
Annual Reports of Municipal Lighting Works Department. 1907 to date.

St. Louis.
Report of Public Service Commission to Municipal Assembly on Rates for Electric Lights and Power. St. Louis, 1911.

Uniform Accounting.
Return forms prescribed by the following states have been examined: California, Connecticut, Idaho, Indiana, Illinois, Maryland, Missouri, New Hampshire, New Jersey, New York, Nevada, Ohio, Oklahoma, Vermont, Wisconsin.

United States. Bureau of the Census.
Eleventh Census. 1890. Report on Manufacturing Industries, Part III. Selected Industries. Electrical Industries in the State of New York (by Allen R. Foote); pp. 237–265. ("Census, 1890.")

United States. Bureau of the Census.
Thirteenth Census. 1910. Abstract with Supplement for Massachusetts, pp. 565–698. Washington, Government Printing Office, 1913; pp. 703.

United States. Bureau of the Census.
Central Electric Light and Power Stations, 1902. Washington, Government Printing Office, 1905; pp. 175. ("Central, 1902.")

United States. Bureau of the Census.
Central Electric Light and Power Stations, 1907. Washington, Government Printing Office, 1910; pp. 197. ("Central, 1907.")

United States. Bureau of the Census.
Central Electric Light and Power Stations and Street and Electric Railways, 1912. Washington, Government Printing Office, 1915; pp. 440. ("Central, 1912.")

United States. Bureau of the Census.
Bulletin 124. Central Electric Light and Power Stations and Street and Electric Railways, 1912. Washington, Government Printing Office, 1914; pp. 113.

United States. Bureau of the Census.
Uniform Municipal Accounting. Washington, 1906; pp. 121.

United States. Department of Commerce.
Circular of the Bureau of Standards, No. 56. Standards for Electric Service. Washington, 1916; pp. 261.
United States. Department of Commerce and Labor.
Bureau of Labor Bulletin, No. 62. January, 1906. Municipal Ownership in Great Britain; pp. 1–123. By Frederic C. Howe.
United States. Department of Commerce and Labor, Department of Municipal Ownership.
Reports from United States Consular Officers. 1897–1905; pp. 55.
United States. Department of Labor.
Commissioner of Labor. Fourteenth Annual Report. House Document No. 713, 56th Congress, 1st Session. Water, Gas, and Electric Light Plants under Private and Municipal Ownership. Washington, Government Printing Office, 1900; pp. 963. ("U.S. Labor. XIV.")
United States. Industrial Commission.
Report, vol. IX. Washington, 1901; pp. cciii, 1052 (pp. 275–285).
United States. Library of Congress.
List of References on Municipal Ownership.
Wisconsin. Railroad Commission.
Annual Reports. 1907 to date. (Particularly, vol. III.)
Wisconsin. Railroad Commission.
Rates of Public Utilities in Wisconsin. Part I. Electric Rates. Madison, 1912; pp. 234.
Wisconsin. Railroad Commission.
Uniform Classification of Accounts for Electrical Utilities. 3d ed. Madison, 1912; pp. 130.

III. Articles in Periodicals; Transactions and Proceedings of Technical Societies

Adams, Alton D.
Cost of Light in Municipal and Private Gas and Electric Plants. *Municipal Engineering*, vol. XXIII (Sept., 1902), pp. 160–164.
Adams, Alton D.
Costs and Prices of Gas and Electric Lighting by Municipal Plants. *Municipal Engineering*, vol. XXV (Oct., 1903), pp. 232–240.
Adams, Alton D.
Municipal Gas and Electric Plants in Massachusetts. *Journal of Political Economy*, vol. X (March, 1902), pp. 214–229.
Adams, Alton D.
Municipal Gas and Electric Plants in Massachusetts. *Political Science Quarterly*, vol. XVII (June, 1902), pp. 247–255.
Adams, Alton D.
The Holyoke Case. *Quarterly Journal of Economics*, vol. XVII (Aug., 1903), pp. 643–668.
American Institute of Electrical Engineers.
Transactions. Vol. XVIII, Part II, p. 1482 (1909). (Chart showing investment costs for steam-turbine plants, etc. By H. G. Stott.)

Annals of the American Academy of Political and Social Science.
Municipal Ownership and Municipal Franchises. Vol. XXVII (Jan., 1906); pp. 233.

Annals of the American Academy of Political and Social Science.
Control of Municipal Public Service Corporations. Vol. XXXI (May, 1908); pp. 201.

Annals of the American Academy of Political and Social Science.
State Regulation of Public Utilities. Vol. LIII (May, 1914); pp. 357.

Annals of the American Academy of Political and Social Science.
Conference of American Mayors on Public Policies as to Municipal Utilities. Vol. LVII (Jan., 1915); pp. 357.

Arena.
Opposing Views on Municipal Ownership. Vol. XXXVII (Feb., 1907), pp. 181–190.

Bauer, John.
Bases of Valuation in the Control of Return on Public Utility Investments. *American Economic Review*, vol. VI (Sept., 1916), pp. 568–588.

Bonbright, James C.
Depreciation and Rate Control. *Quarterly Journal of Economics*, vol. XXX (May, 1916), pp. 546–558.

Bowker, R. R.
Public Control, Ownership, or Operation of Municipal Monopolies. *Municipal Affairs*, vol. I (Dec., 1897), pp. 605–630.

Brooks, Robert C.
Municipalization of the Berlin Electric Works. *Quarterly Journal of Economics*, vol. XXX (Nov., 1915); pp. 188–194.

Burdett, E. W.
Municipal Ownership in Great Britain. *Journal of Political Economy*, vol. XIV (May, 1906), pp. 257–314.

Christie, A. G.
Municipally Operated Industries of Western Canada. New York, 1916; pp. 289–343. (Paper presented at Fourth Midwinter Convention of the American Institute of Electrical Engineers. Reprint.)

Concerning Municipal Ownership. New York, 1906–1909 (June), 1913–1916 (October). (Published monthly till discontinued.)

Commons, John R.
Municipal Electric Lighting. *Municipal Affairs*, vol. I (Dec., 1897), pp. 631–673.

Davis, Joseph S.
Depreciation and Rate Control: a Criticism. *Quarterly Journal of Economics*, vol. XXIX (Feb., 1915), pp. 362–378.

Dickerman, J. C.
Comparison of Electric Light Rates and Power Rates.
Power, vol. XLII (July 6, 1915), pp. 8–15.

Eastman, J. B.
The Public Utility Commissions in Massachusetts; Proceedings, National Municipal League, 1908; pp. 288–307.

Electrical Times. London. Weekly. (Supplements on Cost of Electric Service, etc.)

Erickson, Halford.
The Advantages of State Regulation. *Annals of the American Academy of Political and Social Science,* vol. LVII (Jan., 1915), pp. 123–162.

Erickson, Halford.
Electric Lighting and Power Rates. *Annals of the American Academy of Political and Social Science,* vol. LIII (May, 1914), pp. 238–250.

Foster, Horato A.
Public Lighting by Municipal Plants. *Electrical Engineer,* vol. XVIII (Sept. 5, 1894), pp. 181–189.

Gray, J. H.
The Gas Commission of Massachusetts. *Quarterly Journal of Economics,* vol. XIV (Aug., 1900), pp. 509–536.

Gray, J. H.
Competition and Capitalization as Controlled by the Massachusetts Gas Commission. *Quarterly Journal of Economics,* vol. XV (Feb., 1901), pp. 254–276.

Heilman, R. E.
Development by Commissions of the Principles of Public Utility Valuation. *Quarterly Journal of Economics,* vol. XXVIII (Feb., 1914), pp. 269–291.

Howe, F. C.
Case for Municipal Ownership. Publications of American Economic Association, 3d Series, vol. VII (Feb., 1906), pp. 113–133.

Larson, C. M.
State Regulation of Municipally Owned Plants. *Journal of the American Waterworks Association,* vol. II (Sept., 1915), pp. 515–537.

Lincoln, Edmond E.
Control of Return on Public Utility Investments. *American Economic Review,* vol. VI (Dec., 1916), pp. 869–873.

Municipal Engineering.
Municipal Electric Light Plants: Rates. Vol. IV (Feb., 1915), pp. 48, 111–112.

Municipal Journal.
Data concerning Street Illumination. Vol. XXXIII (Nov. 7, 1912), pp. 685–696.

Municipal Journal.
Data concerning Municipal and Private Electric Light Plants. Vol. XXXV (Aug. 7, 1913), pp. 171–186.

Municipal Journal.
Lighting and Power Rates of Massachusetts Municipal Plants. Vol. XXXVII (Aug. 27, 1914); pp. 264–272, 274–279.

Municipal Journal.
Municipal Ownership Failures. Vol. XXIII (Oct. 2, 1907), pp. 378–379.

Municipal Journal.
On Municipal Electric Lighting Rates in Massachusetts. Vol. XL (Jan. 6, 1916), p. 12; (Feb. 24, 1916), pp. 266–268.

Nash, L. R.
Depreciation Reserves as Affected by Property Growth. *American Economic Review*, vol. VI (March, 1916), pp. 69–89.

Nash, L. R.
The truth about the Cleveland Municipal Electric Plant. Reprint from *Stone and Webster Journal* (Feb., 1917), pp. 23.

Nation.
Municipal Ownership Investigations. Vol. LXXXII (May 31, 1906), pp. 441–442.

National Electric Light Association.
Report of Committee on Progress. (T. C. Martin.) New York, 1914. (Cf. pp. 44–49, on "Municipal Ownership.")

National Electric Light Association.
Report of Committee on Progress. (T. C. Martin.) New York, 1916; pp. 138.

Palmer, Ray.
Municipal Lighting Rates. *Annals of the American Academy of Political and Social Science*, vol. LVII (Jan., 1915), pp. 33–44.

Parsons, Frank H.
The People's Lights.
1. *Arena*, vol. XIII (June, 1895), pp. 118–130.
2. *Arena*, vol. XIII (July, 1895), pp. 381–400.
3. *Arena*, vol. XIV (Sept., 1895), pp. 86–109.
4. *Arena*, vol. XIV (Nov., 1895), pp. 439–463.

Parsons, Frank.
Article on "Municipal Ownership." (In Bliss, New Encyclopedia of Social Reform, pp. 788–795.)

Public Service. Chicago, 1907, to date. (Published monthly.)

Public Utility Reports. Annotated. Rochester, N. Y., Lawyers' Coöperative Publishing Co., 1915 to date. (Published bi-monthly.)

Rate Research. National Electrical Light Association, Chicago, 1912 to date. (Published weekly.)

Ripley, W. Z.
Capitalization of Public Service Corporations. *Quarterly Journal of Economics*, vol. XV (Nov., 1900), pp. 106–137.

Rosewater, Victor.
The Case of Municipal Electric Lighting. *Municipal Affairs*, vol VI. New York, 1902–1903; pp. 622–635.

Rowe, L. S.
Municipal Ownership and Operation: The Value of Foreign Experience. National Municipal League: Proceedings, 1906, pp. 280–290; also in *American Journal of Sociology*, Sept., 1906.

Sharfman, I. Leo.
Commission Regulation of Public Utilities. A Survey of Legislation. *Annals of the American Academy of Political and Social Science*, vol. LIII (May, 1914), pp. 1–18.

South Norwalk.
Municipal Lighting Plant. National Electric Lighting Association, Report of Committee on Progress. (T. C. Martin.) New York, 1914: pp. 45–47.
South Norwalk.
Municipal Electric Works. By Albert E. Winchester, Superintendent. *Annals of the American Academy of Political and Social Science*, vol. LVII (Jan., 1915), pp. 228–245.
Utilities Magazine. Utilities Bureau, Philadelphia. From July, 1915. (Bi-monthly; then monthly until Feb., 1918.)
Watkins, G. P.
Electrical Rates. The Load Factor and the Density Factor. *Quarterly Journal of Economics*, vol. XXX (May, 1916), pp. 519–545.
Watkins, G. P.
The Theory of Differential Rates, *Quarterly Journal of Economics*, vol. XXX (Aug., 1916), pp. 682–703.
Wilcox, D. F.
Effects of State Regulation upon the Municipal Ownership Movement. *Annals of the American Academy of Political and Social Science*, vol. LIII (May, 1914), pp. 71–84.
Williams, Arthur.
Municipal Ownership: Report for 28th Convention of the Electric Light Association at Denver, Colorado Springs, 1905. New York, New York Edison Co.; pp. 188.
Young, A. A.
Depreciation and Rate Control. *Quarterly Journal of Economics*, vol. XXVIII (Aug., 1914), pp. 630–663.

IV. Monographs, Bulletins, Miscellaneous Reports, Addresses, etc.

American Electrical Directory. E. L. Powers, Chicago, 1898. ("Am. El. D.")
Arnold, Bion Joseph.
Report on Municipal Electric Street Lighting, City of Chicago. Chicago, 1908. Bound with appendix by Arthur Young & Co.; pp. 19.
Ballard, F. W.
Operation of the Cleveland Municipal Light Plant and the 1915 Audit; pp. 27. (Paper read at a meeting of the Cleveland Engineering Society, Jan. 23, 1917.)
Bozell, Harold V., E. E.
Municipal Plant Operation in Oklahoma. (Report on 26 towns.) New York, Municipal Ownership Publishing Co., 1916; pp. 85.
Bryant, John Myron, and Hake, H. G.
Street Lighting. Bulletin No. 51, University of Illinois. Urbana, 1911.
Chicago.
Report of Mr. Palmer, Commissioner of Gas and Electricity, in An-

swer to the Reports of W. G. Clark, G. W. Paullin, and Edward W. Bemis, respecting the Cost of Electrical Energy for Street Lighting. Chicago, 1914; pp. 25.

Erickson, Halford.
Depreciation Problems. Madison, 1915; pp. 49.

Erickson, Halford.
Regulation of Public Utilities. Madison, 1911; pp. 66.

General Electric Company.
Bulletin No. 5112. Schenectady, 1897.

Geneseo.
Report of Committee Appointed by the City Council of Geneseo, Ill., on the Investigation of Fifty-five Middle Western Municipal Lighting Plants. (Comparative table of physical and financial data.) Reprinted by Municipal Ownership Publishing Co.

Grant, A. H.
A List of Defunct Municipal Lighting Plants. 10th ed. New York, The Municipal Ownership Publishing Co., 1916; pp. 94.

Insull, Samuel.
I. Public Control and Private Operation of Public Service Industries.
II. Municipal Ownership. Chicago, The Other Side Publishing Co., 1899; pp. 64.

Insull, Samuel.
Some Advantages of Monopoly in Connection with the Manufacture and Distribution of Electric Energy; pp. 61. (Before the Engineers' Club of Dayton, Ohio, October 6, 1914.)

Insull, Samuel.
The Progress of Economic Power Generation and Distribution. Chicago, 1916; pp. 55.

Iowa.
Electric Central Station Operation in Iowa. By F. A. Fish and H. W. Wagner. Iowa State College of Agriculture and Mechanic Arts, Bulletin 38. Engineering Experiment Station. Ames, Ia., 1915; pp. 164.

Los Angeles.
Report on Government Ownership of Public Utility Service Undertakings; by Committee on Municipal Ownership of the City Club of Los Angeles, 1917; pp. 38.

Marston, Glen.
Facts on Municipal Ownership in 268 Towns and Cities. Chicago, Public Service Publishing Co., 1915; pp. 32.

Matthews, Nathan, Jr.
Municipal Lighting Argument for the Town of Brookline, March 12, 1896; pp. 46. (Revised and condensed.)

Matthews, Nathan, Jr.
Report to the Selectmen of Brookline on a Municipal Arc Light Plant, July 15, 1896; pp. 30. ("Matthews: Rept. Brook.")

Matthews, Nathan, Jr.
Report on Comparative Cost of Public Lighting in Boston and Other

Principal Cities of the Country. Boston, Municipal Printing Office, 1898; pp. 56. ("Matthews: Rept. Comp.")

Milwaukee.
Milwaukee Street Lighting Reports. Citizens' Bureau of Municipal Efficiency, 1916; pp. 136.

Nash, L. R.
Some Commercial Considerations in Central Station Rate Making: An Address, Harvard University, 1915; pp. 14.

Newcomb, H. T.
Public Ownership and the Wage-Earner. Washington, D.C. Press of George E. Howard, 1906; pp. 25.

Ohio.
Complete Reports on Municipally Owned Plants in the State of Ohio. Chicago, Public Service Publishing Co., 1915. (Eleven pamphlets, June, 1914, to April, 1915.)

Plattner, William.
Report to the Committee on the Investigation of the Milford Electric Light and Power Co. North Attleborough, 1915; pp. 62.

Plattner, William.
Report to the Board of Selectmen, etc., on the Investigation of the Spencer Gas Co. North Attleborough, 1914; pp. 43.

South Hadley.
Report of Special Committee Appointed June 2, 1913, to Investigate the Matter of Municipal Lighting for the Town of South Hadley, Mass. (Including Report made to said Committee by William Plattner, Consulting Engineer.) Holyoke, M. J. Doyle Co., 1913; pp. 40.

Stone & Webster.
Operation of Municipal Electric Lighting Plants in Massachusetts and in Lewiston and Bangor, Maine.

Sullivan, J. W.
Municipal and Private Operation of Public Utilities. New York, 123 Bible House, 1908; pp. 128. (Sullivan *v.* Commons.)

Syracuse Lighting Committee.
Cost of Residential Light and of Commercial Light and Power for Twenty-two Plants. Syracuse, 1907; pp. 44. (Cf. pp. 24–38.)

Thompson, Carl D.
Municipal Electric Light and Power Plants in the United States and Canada. Bulletin No. 1 of the Public Ownership League of America. Chicago, 1917; pp. 149.

Wellesley.
Report of Committee on Municipal Lighting Plant for Town of Wellesley. 1900; pp. 52.

Whiting, C. W., M. E.
Report of the Investigation of the Municipal Light Plant of the Town of Reading. Boston (?). 1917; pp. 29.

Wisconsin.
Legislative Reference Bulletins on Municipal Electric Lighting and on Municipal Gas Lighting By E. S. Bradford.

swer to the Reports of W. G. Clark, G. W. Paullin, and Edward W. Bemis, respecting the Cost of Electrical Energy for Street Lighting. Chicago, 1914; pp. 25.

Erickson, Halford.
Depreciation Problems. Madison, 1915; pp. 49.

Erickson, Halford.
Regulation of Public Utilities. Madison, 1911; pp. 66.

General Electric Company.
Bulletin No. 5112. Schenectady, 1897.

Geneseo.
Report of Committee Appointed by the City Council of Geneseo, Ill., on the Investigation of Fifty-five Middle Western Municipal Lighting Plants. (Comparative table of physical and financial data.) Reprinted by Municipal Ownership Publishing Co.

Grant, A. H.
A List of Defunct Municipal Lighting Plants. 10th ed. New York, The Municipal Ownership Publishing Co., 1916; pp. 94.

Insull, Samuel.
I. Public Control and Private Operation of Public Service Industries.
II. Municipal Ownership. Chicago, The Other Side Publishing Co., 1899; pp. 64.

Insull, Samuel.
Some Advantages of Monopoly in Connection with the Manufacture and Distribution of Electric Energy; pp. 61. (Before the Engineers' Club of Dayton, Ohio, October 6, 1914.)

Insull, Samuel.
The Progress of Economic Power Generation and Distribution. Chicago, 1916; pp. 55.

Iowa.
Electric Central Station Operation in Iowa. By F. A. Fish and H. W. Wagner. Iowa State College of Agriculture and Mechanic Arts, Bulletin 38. Engineering Experiment Station. Ames, Ia., 1915; pp. 164.

Los Angeles.
Report on Government Ownership of Public Utility Service Undertakings; by Committee on Municipal Ownership of the City Club of Los Angeles, 1917; pp. 38.

Marston, Glen.
Facts on Municipal Ownership in 268 Towns and Cities. Chicago, Public Service Publishing Co., 1915; pp. 32.

Matthews, Nathan, Jr.
Municipal Lighting Argument for the Town of Brookline, March 12, 1896; pp. 46. (Revised and condensed.)

Matthews, Nathan, Jr.
Report to the Selectmen of Brookline on a Municipal Arc Light Plant, July 15, 1896; pp. 30. ("Matthews: Rept. Brook.")

Matthews, Nathan, Jr.
Report on Comparative Cost of Public Lighting in Boston and Other

Principal Cities of the Country. Boston, Municipal Printing Office, 1898; pp. 56. ("Matthews: Rept. Comp.")

Milwaukee.
Milwaukee Street Lighting Reports. Citizens' Bureau of Municipal Efficiency, 1916; pp. 136.

Nash, L. R.
Some Commercial Considerations in Central Station Rate Making: An Address, Harvard University, 1915; pp. 14.

Newcomb, H. T.
Public Ownership and the Wage-Earner. Washington, D.C. Press of George E. Howard, 1906; pp. 25.

Ohio.
Complete Reports on Municipally Owned Plants in the State of Ohio. Chicago, Public Service Publishing Co., 1915. (Eleven pamphlets, June, 1914, to April, 1915.)

Plattner, William.
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Plattner, William.
Report to the Board of Selectmen, etc., on the Investigation of the Spencer Gas Co. North Attleborough, 1914; pp. 43.

South Hadley.
Report of Special Committee Appointed June 2, 1913, to Investigate the Matter of Municipal Lighting for the Town of South Hadley, Mass. (Including Report made to said Committee by William Plattner, Consulting Engineer.) Holyoke, M. J. Doyle Co., 1913; pp. 40.

Stone & Webster.
Operation of Municipal Electric Lighting Plants in Massachusetts and in Lewiston and Bangor, Maine.

Sullivan, J. W.
Municipal and Private Operation of Public Utilities. New York, 123 Bible House, 1908; pp. 128. (Sullivan *v.* Commons.)

Syracuse Lighting Committee.
Cost of Residential Light and of Commercial Light and Power for Twenty-two Plants. Syracuse, 1907; pp. 44. (Cf. pp. 24–38.)

Thompson, Carl D.
Municipal Electric Light and Power Plants in the United States and Canada. Bulletin No. 1 of the Public Ownership League of America. Chicago, 1917; pp. 149.

Wellesley.
Report of Committee on Municipal Lighting Plant for Town of Wellesley. 1900; pp. 52.

Whiting, C. W., M. E.
Report of the Investigation of the Municipal Light Plant of the Town of Reading. Boston (?). 1917; pp. 29.

Wisconsin.
Legislative Reference Bulletins on Municipal Electric Lighting and on Municipal Gas Lighting By E. S. Bradford.

STATISTICAL APPENDIX

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NOTE

THE following statistical tables cover for the different plants the more important data which have been summarized in the text. They have been arranged with a view to presenting in a readily comparable form those relations which are ordinarily of most significance in a study of this kind. For the reader's convenience the order of the preceding chapters has usually been followed. The composite plants (gas and electric) have in practically all cases been kept separate from the other generating plants, so that individual differences can thus be more readily studied. Because of the relatively large size of Holyoke in the one group of municipal plants, and of Norwood in the other, it has been necessary to give the totals and averages both with and without these plants.

The fully weighted arithmetical or "group" average is used in all cases. Accordingly, the unit cost and unit income are found by dividing the *total* cost or income of a particular sort, for the group of plants, by the *total* number of kilowatt hours generated or sold as the case may be. Other averages are found in a similar manner. For purposes of comparison the current supplied by the public plants for street lighting is included with the current "sold," even though it is not actually paid for in the commercial sense. When, however, there might be any possibility of doubt as to the exact meaning, the term "delivered" or "supplied" is used in place of "sold." Furthermore, if plants fail to report items which it is clearly known should be reported, e.g., the *connected load*, the averages are naturally computed for the remaining plants *only*. Also, when the returns for 1910 were found to be incomplete in certain points, the data have in a few cases been taken for the following year. These and other irregularities are duly mentioned in the footnotes to the various tables.

Finally, due to the difficult and complicated task of copying the basic figures from the returns and putting them through countless operations in order to present them in their present form, it is inevitable that minor errors should have crept into the work. The process of printing has added to the possibility of mistakes. Great care, however, has been exercised at all stages, and every attempt has been made to verify the results by different methods, so that any discrepancies which remain will certainly be insignificant. For these, if such there be, the author craves the indulgence of those readers who are sufficiently interested to look carefully into this Appendix.

Note. The footings of the various dollar columns will not always coincide with the sum found by adding the separate items, due to the fact that the latter are computed to the nearest dollar, while the former include the cents as well.

A. STATISTICS OF GENERATING PLANTS

Municipality	Boilers				Primary power						Dynamos					
	Number		Total rated H.P.		Number of units		Total rated H.P.		Average H.P. per unit		Number		Total rated capacity (K.W.)		Average K.W. per dynamo	
	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915
Braintree	3	3	375	375	3	3	625	625	208	208	4	3	550	515	138	172
Chicopee	4	4	540	965	2	3	750	2,025	375	675	10	3	1,096	1,500	110	500
Concord	3	3	270	270	3	3	550	1,550	183	517	3	3	350	1,033	117	344
Danvers	3	4	375	550	4	5	650	1,265	163	257	7	5	479	1,181	68	236
Hudson	3	3	330	330	3	3	686	953	228	318	3	3	450	650	150	217
Hull	3	2	500	519	4	4	896	896	224	224	4	4	760	955	190	239
Ipswich	3	3	382	282	2	3	300	660	150	220	2	3	180	380	90	127
Mansfield	(1)	(1)	....	....	3	4[4]	495	680	165	170	3	4	340	500	113	125
Marblehead	4	4	520	550	2	4	400	700	200	175	2	4	400	600	200	150
Merrimac	(2)	(2)	....	....	2	2	272	272	136	136	2	2	195	195	98	98
North Attleborough	3	2	750	494	4	4	852	852	213	213	4	4	610	610	153	153
Peabody	3	3	400	667	3	3	1,350	1,350	450	450	3	3	975	975	325	325
Reading	3	3	375	375	3	4	630	1,380	210	345	3	4	500	1,000	167	250
Taunton	3	6	900	2,000	3	4	3,540	5,850	1,180	1,463	6	8	2,442	4,042	407	505
Holyoke	10	14	3,400	5,000	7	8	4,820	14,631	689	1,835	5	5	4,700	10,950	940	1,825
Middleborough	2	1	145	254	6	5[7]	553	435	92	87	2	2	350	350	175	175
Wakefield	2	2	250	250	2	2	250	250	125	125	2	2	200	180	67	90
Westfield	3	4	400	708	3	3	1,485	1,890	495	630	4	3	1,420	1,500	355	500
Total — Holyoke out	45[5]	47[5]	6,512	8,353	62	59	14,252	21,652	....	....	65	60	11,297	16,186[6]	....	....
Average	3.0	3.1	434	557[5]	3.1	3.5	838	1,274	274	367	3.8	3.5	665	951	174	269
Total — Holyoke in	55	61	9,912	13,353	69	67	19,072	36,333	....	....	70	66	15,997	27,116	..	....
Average	3.4	3.8	557	835	3.3	3.7	1,060	2,019	323	542	3.9	3.7	889	1,506	229	411

[1] Oil engines used. [2] Boilers not given. Station rented from Water Works Department. [3] 15 plants [4] Gas and water used.
[5] Middleborough out, 595. [6] All Diesel engines. [7] 3 gas engines (275 H.P.), and 2 water wheels (157 H.P.).
[8] Includes 4 D.C. generators of 296 K.W. capacity.

Company	Boilers				Primary power						Dynamos					
	Number		Total rated H.P.		Number of units		Total rated H.P.		Average H.P. per unit		Number		Total rated capacity (K.W.)		Average K.W. per dynamo	
	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915
Amesbury	3	4	375	500	3	4	795	1,390	265	498	5	5	662	1,470	132	294
Attleboro	7	9	1,349	1,857	5	6	3,850	5,370	670	895	9	10(?)	2,484	3,839	276	384
Buzzard's Bay	2	2	325	400	3	5	780	1,500	260	250	3	6	637	1,014	127	169
Gloucester	4	4	500	1,000	4	3	2,070[4]	2,320	518	773	10	7	1,630	2,370	163	339
Great Barrington	1	1	150	150	4[5]	4[5]	489	489	122	122	2	2	222	400	111	200
Lee	2	2	350	350	3[6]	3[6]	445	420	148	140	3	3	410	270	137	90
Leominster	4	4	600	900	4	4	1,375	1,545	344	386	4	3	1,076	925(?)	269	308
Northampton	4	6	600	1,200	3	3	1,525	1,445	508	482	5	5	1,195	1,195	239	239
Plymouth	3	4	550	1,000	2	2	1,000	1,000	500	500	4	2	752	720	188	360
Quincy	4	4	1,000	1,000	3	3	1,690	3,460	563	1,153	3	3	1,416	2,600	157	867
Weymouth	3	3	450	1,136	5[4]	7	1,450[8]	3,795[16]	290	542	5	7	750	2,780	150	397
Winchendon	(1)	(1)	....	....	2	2	350[7]	350[7]	175	175	1	1	120	250	120	250
Beverly	4	5	699	1,129	3	3	1,275	2,010	425	670	3	3	1,119	1,500	140	500
Citizens'	2	2	220	240	3	4	199	333[11]	66	83	4	5	170	276	43	55
Newburyport	3	3	600	600	3	3	925	1,350	308	450	5	3	555	900	111	300
North Adams	7	7	1,530	1,560	6	3	2,125[9]	2,580	521	893	13	3	1,750	2,000	135	667
Vineyard	3	5	450	850	3	4	350[9]	920[12]	117	230	5	6	334[13]	712[14]	67	119
Total	56	65	9,798	13,874	59	64	21,193	30,977	....	....	97	74	15,281	23,221[15]	....	....
Average	3.5	4.1	612	867	3.5	3.8	1,247	1,822	360	484	5.7	4.4	900	1,366	158	314

[1] Current purchased in 1910. Water power generation only in 1915.
[3] 3 water wheels included (339 H.P.). [5] 1 water wheel included (145 H.P.).
[4] 2 water wheels included (400 H.P.). [6] 250 H.P. not in use.
[8] 400 H.P. leased. [7] All water wheels. [9] 425 H.P. not in use.
[10] 150 H.P. leased. [16] 400 H.P. leased. [11] 85 H.P. not in use.
[12] 290 H.P. not in use. [13] 137 K.W. leased. [14] 175 K.W. not in use.
[16] Includes 10 D.C. generators of 436 K.W. capacity.

Municipality	No. K.W.H. made	Current bought		Total No. K.W.H.	Used by plant		Unaccounted for		Current delivered	
		No. K.W.H.	Per cent of total		No. K.W.H.	Per cent of total	No. K.W.H.	Per cent of total	No. K.W.H.	Per cent of total
Braintree	599,155	....	....	599,155	33,000	5.5	128,695	21.5	437,460	73.0
Chicopee	999,570	1,099,220	52.4	2,098,090	108,457	5.2	815,068	38.8	1,175,565	56.9
Concord	861,040	....	....	861,040	20,410	2.4	157,376	18.3	683,654	79.3
Danvers	2,533,175	....	....	2,533,175	159,861	6.3	337,146	13.3	2,036,168	80.4
Hudson	597,908	....	....	597,908	9,860	1.6	137,507	23.0	450,541	75.4
Hull	414,130	233,500	36.1	647,630	25,991	4.0	170,087	26.3	451,552	69.7
Ipswich	424,653	....	....	424,653	11,826	2.8	97,996	23.1	314,831	74.1
Mansfield	609,490	41,150	6.3	650,640	178,967	27.5	87,983	13.5	383,670	59.0
Marblehead	904,800	....	....	904,800	12,708	1.4	204,940	22.6	687,152	76.0
Merrimac	213,955	....	....	213,955	2,000	0.9	56,530	26.4	155,425	72.7
North Attleborough	56,710	608,140	91.5	665,850	3,326	0.5	117,404	17.3	545,120	81.2
Peabody	1,955,720	....	....	1,955,720	10,000	0.5	211,212	10.8	1,734,508	88.7
Reading	909,626	....	....	909,626	8,712	1.0—	218,119	24.0	682,791	75.0
Taunton	4,155,600	....	....	4,155,600	87,000	2.1	1,074,299	25.9	2,994,301	72.1—
Holyoke	13,455,100	....	....	13,455,100	318,490	2.4	1,742,189	13.0—	11,394,421	84.6
Middleborough	438,276	....	....	438,276	20,418	4.7	119,977	27.4	297,881	67.9
Wakefield	74,344	381,461	83.7	455,805	4,397	1.0—	82,240	18.0	369,168	81.0
Westfield	1,659,046	....	....	1,659,046	16,506	1.0	49,788	3.0(?)	1,593,750	96.0
Total — Holyoke out	17,408,398	2,364,471	12.0	19,772,869	713,461	3.6	4,066,371	20.6	14,992,637	75.8
Average	1,024,023	139,087	....	1,163,110	41,968	....	239,229	....	881,914	....
Total — Holyoke in	20,863,498	2,364,471	7.1	33,227,969	1,031,951	3.1	5,808,060	17.5	26,388,958	79.4
Average	1,734,639	151,900	....	1,845,998	57,331	....	322,725	....	1,465,942	....

Company	No. K.W.H. made	Current bought		Total No. K.W.H.	Used by plant		Unaccounted for		Current sold	
		No. K.W.H.	Per cent of total		No. K.W.H.	Per cent of total	No. K.W.H.	Per cent of total	No. K.W.H.	Per cent of total
Amesbury	1,279,392	15,669	1.2	1,295,061	89,517	6.9	330,184	25.5	875,360	67.6
Attleboro	3,071,000	166	....	3,071,166	116,714	3.8	648,668	21.1	2,305,784	75.1
Buzzard's Bay	594,884	1,900	0.3	596,784	3,000	0.5	59,488	10.0	534,296	89.5
Gloucester	1,591,650	....	....	1,591,650	162,014	10.2	247,014	15.5	1,182,622	74.3
Great Barrington	564,238	272,051	32.5	836,289	13,672	1.6	269,545	32.2	553,072	66.2
Lee	183,284	527,350	74.2	710,634	4,200	0.6	92,384	13.0	614,050	86.4
Leominster	1,763,260	818,359	31.7	2,581,619	146,972	5.7	173,963	6.7	2,260,684	87.6
Northampton	2,085,110	....	....	2,085,110	152,246	7.3	256,123	12.3	1,676,741	80.4
Plymouth	1,979,290	....	....	1,979,290	23,032	1.2	130,985	6.6	1,825,273	92.2
Quincy	2,721,188	....	....	2,721,188	46,053	1.7	420,525	15.5—	2,254,608	82.9—
Weymouth	2,694,035	....	....	2,694,035	?	?	504,083	18.7	2,189,952	81.3
Winchendon	193,780	313,188	61.8	506,968	5,536	1.1	77,845	15.4	423,567	83.5
Beverly	2,575,135	....	....	2,575,135	98,284	3.8	290,964	11.3	2,185,887	84.9
Citizens'	78,712	....	....	78,712	3,000	3.9	11,760	14.9	63,952	81.2
Newburyport	1,215,942	....	....	1,215,942	10,288	0.9	191,977	15.7	1,014,577	83.4
North Adams	5,098,350	....	....	5,098,350	445,769	8.8	496,383	9.7	4,155,698	81.5
Vineyard	361,797	....	....	361,797	3,500	1.0—	36,179	10.0	322,118	89.0
Total	28,051,545	1,948,683	6.5	30,000,228	1,334,817	4.9	4,337 170	13.6	24,438,241	81.5
Average	1,650,091	114,638	....	1,764,719	82,801 [1]	....	249,245	....	1,437,549	....

[1] Weymouth omitted.

Municipality	Commercial and domestic lighting		Public buildings		Street lighting		Power		Other companies	
	No. K.W.H. sold	Per cent of total delivered	No. K.W.H. sold	Per cent of total delivered	No. K.W.H. supplied	Per cent of total delivered	No. K.W.H. sold	Per cent of total delivered	No. K.W.H. sold	Per cent of total delivered
Braintree	245,336	26.1	3,697	0.3	143,430	32.8	45,000	10.3	....	....
Chicopee	322,566	27.5	57,590	4.9	392,089	33.4—	402,322	34.2	....	....
Concord	333,663	43.6	23,969	3.5	190,710	27.9	135,312	19.8	....	....
Danvers	287,340	14.1	3,612	0.2	333,108	16.4	1,393,265	68.4	16,842	0.9
Hudson	156,706	34.8	5,206	1.1	92,178	20.5	196,451	43.6	....	....
Hull	292,432	64.8—	6,640	1.5—	77,646	17.2	74,429	16.5—	405	0.1
Ipswich	126,772	40.3—	4,409	1.4	142,520	45.3—	....	....	41,180	13.1—
Mansfield	144,067	37.6—	6,785	1.8—	86,904	22.7—	144,014	37.5—	980	0.3—
Marblehead	263,293	39.0	19,294	2.9	279,064	40.6	120,505	17.5	....	....
Merrimac	37,808	17.9	1,200	0.6	37,435	24.1	83,982	57.3	....	....
North Attleborough	131,486	33.3	5,927	1.0	110,510	20.3—	247,237	45.4—	....	....
Peabody	304,922	17.6	19,142	1.1	283,000[1]	16.3	1,100,844	63.5	25,300	1.5
Reading	299,773	43.9	7,684	1.1	204,321[2]	29.9	131,787	19.3	39,230	5.7
Taunton	653,310	21.8	52,917	1.8	673,168	22.5	1,614,406	53.9	....	....
Holyoke	2,726,285	33.9	171,510	1.5	1,058,500	9.2	7,199,269	63.2	238,867	2.1
Middleborough	162,723	54.6	9,250	3.1	42,658	14.4	83,350	27.9	....	....
Wakefield	170,439	46.2	6,869	1.9	154,797	41.9	37,013	10.0	....	....
Westfield	390,791	24.5	33,313	2.1	411,536	25.8	737,111	47.5	....	....
Total — Holyoke out	4,369,979	29.2	267,498	1.8	5,655,074	24.8—	6,572,928	43.8+	126,888	0.9
Average	257,058	....	15,735	....	215,004	....	386,637	....	7,464	....
Total — Holyoke in	7,096,264	26.9	439,008	1.7	4,713,574	17.8	13,772,097	52.2	365,745	1.4
Average	394,238	....	24,389	....	261,865	....	765,117	....	20,320	....

[1] Includes 9,962 K.W.H. sold for street lighting to other towns.

[2] Includes 47,324 K.W.H. sold for street lighting to other towns.

Company	Commercial and domestic lighting		Street lighting		Power		Other companies	
	No. K.W.H. sold	Per cent of total sold	No. K.W.H. sold	Per cent of total sold	No. K.W.H. sold	Per cent of total sold	No. K.W.H. sold	Per cent of total sold
Amesbury	169,123	19.3	98,344	11.3	607,893	69.4	....	....
Attleboro	540,772	23.5—	207,829	9.0	1,554,549	67.4	2,634	0.1
Buzzard's Bay	434,310	81.3	67,177	12.6	32,809	6.1	....	....
Gloucester	570,928	47.9	293,700	25.2	317,994	26.9	....	....
Great Barrington	207,349	37.5	57,266	10.3	288,457	52.2	....	....
Lee	275,975	44.9	22,455	3.7	315,620	51.4	....	....
Leominster	286,680	12.7	177,470	7.9	1,449,597	64.1	346,937	15.3
Northampton	659,013	39.3	230,763	13.8	676,155	40.3	110,810	6.6
Plymouth	688,037	37.7	125,840	6.9	834,841	45.7	176,555	9.7
Quincy	870,469	38.6	500,429	22.2	883,710	39.2	....	....
Weymouth	500,503	22.9	82,446	3.3	494,806	22.6	1,112,197	51.2
Winchendon	132,493	31.3	61,055	14.4	227,799	53.8	2,220	0.5
Beverly	772,724	35.4	896,566	41.0	248,707	11.4	267,900	12.2
Citizen's	39,972	62.5	23,980	37.5	....	....	....	....
Newburyport	218,203	21.5	321,320	31.7	475,054	46.8	....	....
North Adams	847,670	20.4	293,648	7.0	2,001,279	48.2—	1,013,091	24.4—
Vineyard	266,075	82.6	33,100	10.3	22,943[1]	7.1	....	....
Total	7,480,296	30.6	3,493,388	14.3	10,432,213	42.7	3,032,344	12.4
Average	440,017	....	205,493	....	613,660	....	178,373	....

[1] Includes 16,450 K.W.H. sold to street railway.

COMPARATIVE OUTPUT OF CURRENT (1910–1915)

Municipality	No. K.W.H. generated and purchased		No. K.W.H. delivered		K.W.H. used by plant and unaccounted for			
					1910		1915	
	1910	1915	1910	1915	No.	Per cent	No.	Per cent
Braintree	896,375	599,155	353,240	437,460	43,035	11.0	161,695	27.0
Chicopee	1,320,160[1]	2,099,090	1,188,144[1]	1,175,865	132,016[1]	10.0	923,225	44.0
Concord	597,760	861,940	431,951	683,654	155,809	26.0	178,286	20.7
Danvers	766,572	2,533,175	591,027	2,036,168	165,545	22.0	497,007	19.6
Hudson	514,003	597,908	374,736	450,541	139,267	27.2	147,367	24.5
Hull	270,320	647,830	202,418	451,552	67,902	25.0	196,278	30.3
Ipswich	289,392[1]	424,653[1]	216,971	314,331	62,921	20.0	109,322	25.9
Mansfield	490,430	650,640	304,315	383,670	186,115	38.0	266,970	41.0
Marblehead	620,542	904,800	499,475	687,153	121,067	19.5	217,648	24.0
Merrimac	237,690	213,955	196,201	155,425	41,489	17.5	58,530	27.3
North Attleborough	397,000	665,850	277,388	545,120	119,612	30.0	120,730	17.5
Peabody	692,128(?)	1,955,720	542,002	1,734,508	150,126	21.5	221,212	11.3
Reading	575,500	909,628	510,431	692,791	165,069	24.4	226,831	25.0
Taunton	2,506,100	4,155,600	1,883,338	2,994,301	626,762	25.0	1,161,299	28.0
Holyoke	8,967,120	13,455,100	7,932,966	11,394,421	1,034,154	11.4	2,060,679	15.4—
Middleborough	272,705	438,276	189,686	297,881	83,019	30.5	140,395	32.1
Wakefield	225,514	455,805	185,265	369,168	43,249	19.0	86,637	19.0
Westfield	956,400	1,659,046	837,001	1,592,750	119,399	12.5	66,296	4.0
Total — Holyoke out	11,194,291	19,772,889	8,783,689	14,992,537	2,410,802	21.5	4,780,382	24.2
Average	658,488	1,163,110	516,688	881,914	141,800	....	281,196	....
Total — Holyoke in	20,161,411	33,227,989	16,716,655	26,386,958	3,444,756	17.0	6,841,011	20.6
Average	1,120,000—	1,845,998	928,703	1,466,942	190,820	....	380,056	....

[1] For 1911. Returns wrong for 1910.

[2] Estimated.

COMPARATIVE OUTPUT OF CURRENT (1910–1915) 401

Company	No. K.W.H. generated and purchased		No. K.W.H. sold		K.W.H. used at station and unaccounted for			
	1910	1915	1910	1915	1910		1915	
					No.	Per cent	No.	Per cent
Amesbury	1,005,520	1,295,061	698,534	875,360	311,986	31.0	419,701	32.4
Attleboro	2,428,940	3,071,166	1,904,315	2,305,784	524,625	21.5	756,382	24.9
Buzzard's Bay	61,121[1]	596,784	(50,000)[2]	534,296	(11,121)[2]	?	62,488	10.5
Gloucester	1,197,010	1,591,650	750,574	1,182,622	446,436	37.2	409,028	25.7
Great Barrington	680,713	836,289	573,761	553,072	106,952	15.7	283,217	33.8
Lee	174,752	710,634	132,585	614,050	42,167	24.0	96,584	13.6
Leominster	1,253,222	2,581,619	1,129,545	2,260,684	123,677	10.0	320,935	12.4
Northampton	1,356,470	2,085,110	1,112,363	1,676,741	244,107	18.0	408,369	19.6
Plymouth	1,134,201	1,979,290	730,476	1,825,273	403,737	35.5	154,017	7.8
Quincy	1,801,002	2,721,186	1,011,687	2,254,608	789,315	43.8	466,578	17.2
Weymouth	921,889	2,694,035	844,746(?)	2,189,952	77,143	8.4	504,083	18.7
Winchendon	181,000	506,968	175,201	423,567	5,799	3.2	83,401	16.5
Beverly	1,590,397	2,575,135	1,322,586	2,185,887	267,811	16.7	389,248	15.1
Citizens'	68,000	78,712	61,558	63,952	6,442	9.5	14,760	18.8
Newburyport	774,059	1,215,942	631,759	1,014,577	142,300	18.5	201,365	16.6
North Adams	3,974,594[1]	5,098,850	3,274,550[1]	4,155,698	700,044[1]	17.5	943,152	18.5
Vineyard	149,383[1]	361,797	126,299[1]	322,118	23,084[1]	15.4	39,679	11.0
Total	18,752,273	30,000,228	14,475,533	24,438,241	4,215,625	22.2	5,561,987	18.5
Average	1,103,075	1,764,719	904,721	1,437,544	263,477	....	327,176	....

[1] For 1911. Returns incomplete in 1910.

[2] Estimated — not included in average.

COMPARATIVE SALES OF CURRENT (1910–1915)

Municipality	No. K.W.H. supplied for street lighting [1]		No. K.W.H. sold for commercial and domestic lighting [2]		No. K.W.H. sold for power		No. K.W.H. sold to other companies		No. K.W.H. purchased		No. K.W.H. generated per K.W. capacity of dynamos	
	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915
Braintree	163,440	143,450	183,612	249,080	6,288	45,000	....	....	....	....	720	1,150
Chicopee	342,304	392,089	385,740	381,156	460,000(?)	402,322	....	....	....	1,099,220	1,200	667
Concord	152,155	190,710	252,328	367,632	27,468	135,312	....	....	....	....	1,679	860
Danvers	143,639	333,108	221,769	290,952	225,619	1,393,265	....	18,843	....	....	1,580	2,110
Hudson	63,373	92,178	126,601	161,922	184,762	196,451	....	....	....	....	1,140	920
Hull	37,522	77,646	149,519	298,072	3,387	74,429	11,990	405	....	233,500	360	420
Ipswich	146,952	142,520	70,019	131,181	....	....	....	41,130	....	....	1,500	1,120
Mansfield	102,399	86,904	103,607	150,872	96,906	144,914	1,404	960	....	41,150	1,442	1,220
Marblehead	191,527	279,064	261,229	287,587	46,719	120,505	....	....	....	....	1,550	1,508
Merrimac	34,965	37,435	23,031	29,008	138,205	88,969	....	....	....	....	1,190	1,070
North Attleborough	89,530	110,510	168,648	187,393	17,592	247,237	....	....	....	609,140	651	93
Peabody	295,300	273,088	212,900	334,026[3]	33,802	1,100,844	....	26,300	74,334	....	620	2,000
Reading	227,340	156,997	141,287	354,781[3]	70,458	131,787	71,944	39,230	....	....	1,351	910
Taunton	552,334	673,168	326,731	708,727	904,278	1,614,406	....	....	....	....	1,030	1,030
Holyoke	891,400	1,058,500	1,522,921	2,897,795	5,518,645	7,199,269	....	238,857	....	....	1,900	1,228
Middleborough	40,599	42,658	114,471	180,499	84,616	83,250	....	....	....	....	780	1,262
Wakefield	83,642	84,797	101,623	177,358	....	87,013	....	....	71,344	381,461	786	413
Westfield	313,000	411,536	324,607	424,109	199,394	787,111	....	....	....	....	674	1,106
Total — Holyoke out	3,080,111	3,597,786[4]	3,167,723	4,694,763	2,449,458	6,572,828	84,738	126,888	146,178	2,364,471	976	1,077
Total — Holyoke in	3,971,511	4,656,288	4,690,643	7,592,578	7,968,103	13,772,097	....	365,745	....	....	1,250	1,143

[1] Includes only the current used at home.

[2] Current sold to public buildings included, as well as a little sold to other towns for street lighting in 1915.

[3] Includes some sold for street lighting in other towns.

[4]

Company	No. K.W.H. sold for street lighting		No. K.W.H. sold for commercial and domestic lighting		No. K.W.H. sold for power		No. K.W.H. sold to other companies		No. K.W.H. purchased		No. K.W.H. generated per K.W. capacity of dynamos	
	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915
Amesbury	76,350	96,344	113,482	169,123	503,702	607,893	....	....	34,151	15,669	1,500	870
Attleboro	175,308	207,529	399,346	540,772	1,329,661	1,554,549	....	2,634	....	166	972	810
Buzzard's Bay	10,271[1]	67,177	?	434,310	?	32,809	....	....	....	1,900	95	535
Gloucester	223,200	293,700	390,945	570,928	136,429	317,994	....	....	....	....	735	670
Great Barrington	75,510	57,256	165,676	207,349	253,372	288,457	79,103	....	79,103	272,051	2,700	1,410
Lee	17,601	22,465	114,984	275,975	....	315,620	....	....	....	527,350	426	690
Leominster	200,430	177,470	213,561	286,680	715,534	1,449,597	....	346,937	....	618,359	1,140	1,900
Northampton	270,304	230,703	530,551	659,013	186,606	676,155	124,900	110,810	....	....	1,130	1,740
Plymouth	67,560	125,340	301,768	688,037	361,142	834,841	....	176,565	433,601	....	870	2,760
Quincy	339,894	500,429	401,965	870,469	269,828	883,710	....	....	....	....	1,285	1,050
Weymouth	73,287	82,446	142,746	500,503	286,236	494,806	342,498	1,112,197	....	....	1,230	962
Winchendon	48,225	61,055	126,976	132,498	....	227,799	....	2,220	181,000	313,188	(2)	735
Beverly	532,460	696,556	476,108	772,724	120,418	248,707	193,600	267,000	....	....	1,445	1,720
Citizens'	27,000	23,980	34,558	39,972	....	....	....	....	....	....	400	285
Newburyport	128,158	321,320	156,432	218,208	347,168	675,054	....	....	....	....	1,400	1,350
North Adams	347,801[1]	1293,548	773,542[1]	847,670	1,443,655[1]	2,001,279	709,562[1]	1,013,091	....	....	2,270	2,550
Vineyard	28,833[1]	33,100	76,091[1]	266,075	21,375[1]	22,943	....	....	....	....	450	500
Total	2,842,273	3,493,388	4,418,751	7,480,296	6,975,127	10,432,313	1,443,653	3,032,344	727,895	1,948,683	1,176	1,307

[1] For 1911. Returns for 1910 incomplete.

[2] All current bought.

CUSTOMERS AND INHABITANTS

Municipality	Total [illegible] of customers		No. of customers using light		No. of customers using power		Ratio of customers to inhabitants of district served (per cent)		No. of inhabitants in district served	
	1910	1915	1910	1915	1911	1915	1910	1915	1910	1915
Braintree	828	1,406	823	1,408	13	29	10.3	15.0	8,008	9,343
Chicopee	776	1,784	774	1,778	26	47	3.0	6.0	25,401	30,136
Concord	713	900	701	888	43	87	11.1	12.9	6,421	6,881
Danvers	728	1,604	728	1,604	45	76	7.7	13.0	9,407	11,177
Hudson	438	712	431	706	29	45	6.5	9.0	6,743	7,886 [2]
Hull	796	1,678	796	1,679	17	109	38.0	72.3	2,103	2,239
Ipswich	245	502	245	502	....	....	4.2	8.0	5,777	6,273
Mansfield	271	571	266	564	20	62	5.2	10.0	5,163	5,772
Marblehead	1,025	1,386	1,020	1,365	42	56	14.0	18.2	7,338	7,606
Merrimac	75	175	74	175	3	11	3.4	8.3	2,202	2,101
North Attleborough	549	892	549	889	25	43	5.7	9.5	9,563	9,396
Peabody	555	1,406	551	1,283	63	125	5.4	7.2	15,721	19,737 [3]
Reading	666	1,518	632	1,507	41	55	11.4	13.2	5,818	11,539 [4]
Taunton	568	1,253	546	1,227	62	135	1.7	3.5	34,250	36,161
Holyoke	1,992	5,042	1,944	5,009	216	270	3.3	3.3	57,730	80,816
Middleborough	364	625	362	618	35	31	4.4	7.2	8,214	8,631
Wakefield	320	762	304	762	9	22	2.6	6.0	11,404	12,731
Westfield	235	1,124	222	1,054	67	115	1.3	6.2	16,044	18,411
Total — Holyoke out	9,500	18,0591	9,364	17,797	595	1,047	5.3	8.8	179,668	205,923
Average	559	1,063	551	1,047	35	62	....	....	10,568	12,113
Total — Holyoke in	11,392	23,111	11,208	23,800	811	1,317	4.5	8.7	223,508	266,739
Average	533	1,284	62.3	1,267	45	73	....	....	13,250	14,819

[1] Of this number, 567 are in foreign districts. [2] Includes 1,127 in other towns. [3] Includes 1,112 in other towns. [4] Includes 3,622 in other towns.

Company	Total no. of customers		Customers using light		Customers using power		Ratio of consumers to inhabitants of district served (per cent)		No. of inhabitants in district served	
	1910	1915	1910	1915	1911	1915	1910	1915	1910	1915
Amesbury	274	895	268	869	55	84	2.8	8.7	9,894	10,260
Attleboro	840	1,877	836	1,874	98	138	4.5	10.2	18,612	18,480
Buzzard's Bay	68	1,015	67	1,013	2	37	2.2	6.7	3,144	15,263
Gloucester	1,377	2,438	1,358	2,336	104	332	4.8	8.0	28,609	30,508
Great Barrington	479	760	473	754	108	103	5.7	8.4	8,348	9,088
Lee	301	442	301	442	3	39	4.2	5.7	7,166	7,723
Leominster	821	1,115	792	1,040	99	76	4.3	6.3	18,973	17,646
Northampton	876	1,621	865	1,477	265	148	4.5	7.5	19,431	21,652
Plymouth	709	1,816	683	1,780	96	166	4.4	9.5	16,274	19,152
Quincy	1,899	4,262	1,870	4,214	71	146	5.8	10.5	32,642	40,674
Weymouth	606	1,449	606	1,448	31	25	4.7	10.4	12,895	13,969
Winchendon	206	302	206	298	9	21	3.6	5.1	5,678	5,906
Beverly	1,000	1,887	995	1,884	50	57	4.4	7.0	22,563	27,079
Citizens'	222	348	222	348	....	....	7.5	11.0	2,962	3,166
Newburyport	324	571	317	565	48	51	2.0 —	3.1	16,431	18,330
North Adams	1,340	2,070	1,328 (1,483)[2]	1,957	67	119	5.8	8.9	23,226	23,149
Vineyard	192	549	190 (373)[2]	548	4	9	8.0	14.3	2,280	3,845
Total	11,536	23,417[1]	11,374	22,847	1,108	1,539	4.6	8.2	249,148	285,890[3]
Average	679	1,377	669	1,344	65	91	....	....	14,656	16,817

[1] Of this number, 2,924 are in foreign territory. [2] In 1911. [3] Of this number, 41,369 are in foreign territory.

Municipality	No. K.W.H. consumed per customer						No. K.W.H. consumed per inhabitant of district served								K.W. capacity of dynamos per customer		No. K.W.H. consumed per K.W. capacity of dynamos	
	Total		Light		Power		Total [1]		Commercial and domestic light		Street lighting		Power					
	1910	1915	1910	1915	1911	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915
Braintree	229	209	223	177	960	1,552	44.0	47.0	22.5	26.6	20.3	15.3	0.3	4.9	0.66	0.37	642	850
Chicopee	343[1]	439	500	214	17,700	8,560	47.0	39.9	15.3	12.6	13.4	13.0	18.1	13.4	1.41	0.84	1,084	784
Concord	392	573	360	417	1,470	1,556	67.0	102.3	33.3	53.5	23.7	28.5	4.3	20.3	0.49	1.20	1,294	693
Danvers	515	1,212	305	207	4,368	18,332	63.0	186.0	23.6	26.0	15.3	30.0	24.0	124.7	0.66	0.84	1,234	1,709
Hudson	714	608	291	229	6,558	4,366	55.5	57.0	19.0	20.5[2]	9.4	13.7[4]	27.4	25.0	1.03	0.91	833	688
Hull	207	223	188	178	1,011	669	90.5	197.0	71 1	130.6	17.8	33.9	1.6	32.5	0.95	0.57	251	473
Ipswich	286	343	286	261	....	....	38.0	43.6	12.1	21.0	25.4	22.7	....	....	0.73	0.76	1,205	829
Mansfield	745	520	382	264	2,753	2,785	58.0	66.0	20.0	26.0	19.8	15.4	18.7	25.1	1.25	0.88	891	787
Marblehead	300	294	255	207	1,183	2,152	67.0	90.0	35.6	38.0	26.1	26.7	6.4	16.0	0.39	0.48	1,249	1,145
Merrimac	2,150	674	311	166	16,368	8,089	89.9	74.0	10.5	13.8	15.9	17.9	63.8	42.4	2.60	1.11	1,006	900
North Attleborough	330	487	307	210	2,415	5,857	29.0	58.0	17.6	20.0	9.4	11.8	1.8	20.1	1 11	0.68	455	900
Peabody	289	1,099	250	260	5,070	3,807	35.5	87.0	13.5	17.0[3]	13.3	14.7[4]	2.2	55.5	1.14	0.69	556	1,753
Reading	425	346	213	235	1,333	2,396	75.5	56.0	24.2	30.8[3]	30.1	23.1[5]	12.1	11.4	0.75	0.56	1,021	544
Taunton	2,167	1,852	600	576	13,330	11,969	55.0	82.5	9.5	19.5	19.0	18.6	26.4	44.6	4.39	3.33	771	741
Holyoke	3,732	2,050	826	580	27,925	26,664	137.4	183.0	26.4	47.8	15.4	17.4	95.6	118.4	2.48	2.17	1,688	1,019
Middleborough	410	408	316	292	1,307	2,885	23.0	34.5	14.9	21.0	5.0	5.0	4.2	9.6	0.98	0.56	542	851
Wakefield	316	281	234	233	7	1,157	16.0	29.0	9.0	14.0	7.3	12.1	....	2 9	0.53	(5)	296	(5)
Westfield	1,339	1,042	1,400	402	2,910	6,584	52.0	57.0	20.2	23.0	19.5	22.4	12.4	41.1	5.00	1.52	589	1,052
Average — Holyoke out	601	624	338	264	5,058	6,278	48.4	72.2	17.8	23.9	17.1	18.1	13.6	31.9	1.19	0.88	778 (785)[6]	907 (761)[6]
Average — Holyoke in	1,111	994	419	333	11,173	10,497	70.4	97.6	19.8	26.5	16.7	17.9	33 5	51.6	1.40	1.17	1,045	952

[1] For 1911. [2] Sales to other companies or municipalities excluded. [3] Includes current sold for street lighting in other towns.
[4] Does not include current sold to other towns for street lighting. [5] Generating equipment taken out during year. [6] Excluding current bought

Company	No. K.W.H. consumed per customer						No. K.W.H. consumed per inhabitant of district served								K.W. capacity of dynamos per customer		No. K.W.H. consumed per K.W. capacity of dynamos	
	Total		Light		Power		Total [2]		Commercial and domestic light		Street lighting		Power					
	1910	1915	1910	1915	1911	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915
Amesbury	2,252	868	431	195	9,589	7,237	70.1	35.3	11.5	16.5	7.7	9.6	50.9	39.2	2.42	1.64	1,048	595
Attleboro	2,058	1,116	475	289	16,530	11,688	102.3	124.8	21.5	29.3	9.4	11.2	71.4	84 1	2.78	2.05	814	601
Buzzard's Bay	? [1]	460	?	423	?	887	?	35.0	?	28.5	3.3	4.4(?)	?	2.1	9.37(?)	1.00	?	525
Gloucester	383	305	238	244	1,232	958	26.3	33.7	13.7	18.7	7.8	9.6	4.8	10.4	1.05	0.97	518	500
Great Barrington	375	652	350	275	2,390	2,800	59.1	60.7	20.0	22.7	9.1	6.3	30.0	31.7	2.16	1.90	2,584 [4]	1,333 [4]
Lee	382	1,336	382	624	....	9,363	18.5	79.5	16.0	36.6	2.5	2.9	....	41.0	0.73	1.64	322	2,274 [4]
Leominster	1,132	1,557	270	277	5,930	19,074	60.6	109.0	11.3	16.2	10.6	10.6	38.7	82.2	1.31	0.83	1,051	2,444 [4]
Northampton	519	834	513	446	1,485	4,569	50.6	72.4	27.3	30.4	13.9	10.7	9.6	31.3	1.36	0.74	931	1,403
Plymouth	935	830	444 —	386	5,897	5,029	46.3	87 2	18.5	35.9	5.9	16.6	22.2	44.7	1.02	0.40	1,015	2,535
Quincy	354	411	236	207	5,543	5,053	31.0	55 4	12.3	21.4	10.4	2.3	8.3	21.7	0.56	0.61	809	867
Weymouth	706	643	234	346	9,636	19,792	39.0	77.1	11.1	35.8	5.7	5.9	22.2	35.4	1.25	1.92	1,126	768
Winchendon	616	1,193	616	445	?	10,848	30.8	72.8	23.3	22.5	8.5	10.3	....	40.0	(3)	1.21	(3)	1,694 [5]
Beverly	596	541	477	410	2,468	4,263	53.3	70.8	21.1	28.5	26.9	33.1	5.3	9.2	1.12	0.79	1,182	1,457
Citizens'	156	115	156	99	....	....	20.8	20.2	11.7	12.6	9.1	7.6	....	....	1.77	0.80	302	235
Newburyport	1,554	1,214	500 —	386	8,465	9,515	39.2	54.9	9.5	11.9	8.6	17.5	21.1	25.5	1.71	1.53	1,138	1,127
North Adams	1,000	1,376	522 [1]	433	21,547	16,817	73.5	125.8	24.7	36.6	15.8	12.7	33.0	36.5	1.31	0.97	?	2,078
Vineyard	?	526	204 [1]	455	394	721	?	83.6	?	69.2	8.8	8.6	?	6.0	1.74	1.30	?	452
Average	881	765	380	327	5,462	6,722	52.9	74.9	17.8	26.2	11.0	12.2	24.0	36.5	1.32	1.02	947 (896) [6]	1,052 (968) [6]

[1] For 1911. Buzzard's Bay returns frequently incomplete for 1911.
[2] Sales to other companies and municipalities excluded.
[3] Current purchased in 1910. [4] A large amount of current bought. [5] All current bought. [6] Excluding current bought.

CONNECTED LOAD (1915)

Municipality	Lighting			Power			Total light and power	Total generating capacity (K.W.)	Maximum station load (K.W.)	Maximum station load on day of least output	Load factor
	Commercial	Street	Total	Commercial	Municipal	Total					
Braintree	?	47.72(?)	?	130.00(?)	?	130.00	?	515	2,629 (K.W.H.)	920 (K.W.H.)	?
Chicopee	?	101.11	?	?	?	?	?	1,500	500(?)	280(?)	48.0 (?) (26.7)
Concord	350.40	49.60	1,000.00	62.50	59.12	121.62	1,121.62	1,083	317	158	31.8
Danvers	636.90	95.46[2]	732.36	1,550.00	23.88	1,573.88	2,306.24	1,181	10,500 (K.W.H.)	2,200 (K.W.H.)	?
Hudson	575.00	26.10	601.10	249.00	66.75	315.75	(?) 916.85	650	289 A. (318)	93 A. (102)	21.4
Hull	1,600.00	38.48	1,638.48	366.76	....	366.76	2,005.24	255	580	?	12.5
Ipswich	?	47.70	?	....	....	....	?	380	?	?	?
Mansfield	?	24.40	?	367.00	....	367.00	?	500	226	80	32.9
Marblehead	?	66.15	?	309.00	12.00	321.00	?	600	410	195	25.2
Merrimac	93.44	16.60	110.04	162.68	....	162.68	272.72	195	830 (K.W.H.)	45 (K.W.H.)	?
North Attleborough	1,161.50	47.96	1,209.46	271.50	14.25	285.75	1,495.21	610	490	110	15.8
Peabody	1,440.00	58.20	1,498.80	1,063.20	41.25	1,074.45	2,573.25	975	860	220	26.0
Reading	1,521.69	71.76	1,593.45	155.08	34.30	189.33	1,782.78	1,000	209 A. (481)	110 A. (253)	21.6
Taunton	?	111.40	?	3,008.00	55.00	3,063.00	?	4,042	1,690	880	28.0
Holyoke	7,974.39	228.78	8,203.17	6,172.85	230.32	6,403.17	14,606.34	10,280	4,800	1,059	32.0
Middleborough	685.50	24.26	709.76	243.00	....	243.00	952.76	250	136 A. (150)	50 A. (55)	30.0
Wakefield	?	42.00	?	110.41	....	110.41	?	180	198	?	26.3
Westfield	?	26.83	?	908.00	38.00	946.00	?	1,500	1,656	322	11.4 (?)
Total — Holyoke out	8,665.08	972.73[3]	9,133.19	8,926.06	344.55	9,270.62	13,426.66[4]	16,166	(13) 7,776	(11) 2,155	(13) 25.5
Average	962.78[1]	57.22	....	....	38.28	(16) 579.35	1,491.85	951	598	196	26.5[4]
Total — Holyoke in	16,639.42	1,201.51	....	....	574.87	15,673.80	28,032.01	27,116	(14) 12,576	(12) 3,205	(14) 25.9
Average	1,663.94	66.76	....	....	57.49	(17) 922.00	2,803.80	1,806	....	....	....

[1] Average for 9 plants. [2] Weighted average. [3] Total for 9 plants, 468.16. [4] Includes only 9 plants.

Company	Lighting			Power			Total light and power	Total generating capacity (K.W.)	Maximum station load (K.W.)	Maximum station load on day of least output	Load factor
	Commercial	Street	Total	Commercial	Municipal	Total					
Amesbury	993.30	39.40	1,032.70	1,941.14	....	1,941.14	2,973.84	1,470	550	150	26.9
Attleboro	2,268.20	73.85	2,342.05	1,864.25	20.89	1,885.14	4,227.19	3,839	1,250	200	28.0
Buzzard's Bay	553.19	34.44	587.63	50.73	....	50.73	638.36	1,014	360	30	18.9
Gloucester	3,400.45	106.60	3,507.05	705.50	....	705.50	4,212.55	2,370	780	280	23.3
Great Barrington	786.21	19.25	805.46	870.15	....	870.15	1,675.61	400	231	100	41.3
Lee	592.00	9.60	591.60	245.00	....	245.00	836.60	270	280	90	29.0
Leominster	965.22	52.48	1,017.69	1,247.70	36.00	1,283.70	2,301.39	925	940	165	31.4
Northampton	2,010.46	63.05	2,073.51	1,118.44	17.44	1,135.88	3,209.38	1,195	850	240	28.0
Plymouth	1,707.05	30.00	1,737.05	1,878.36?	....	1,878.36?	3,615.41	720	750	450	31.1
Quincy	4,382.25	109.72	4,491.97	1,474.72	....	1,474.72	5,966.69	2,600	9,956 (K.W.H.)	3,106 (K.W.H.)	?
Weymouth	1,225.00	32.36	1,257.36	1,000.00	....	1,000.00	2,257.36	2,780	800 (?)	290	38.4
Winchendon	386.60	19.40	406.00	281.00	....	281.00	687.00	250	4,598 (K.W.H.)	1,020 (K.W.H.)	?
Beverly	2,515.09	246.43	2,761.52	276.95	26.61	303.56	3,065.08	1,500	8,800 (K.W.H.)	5,035 (K.W.H.)	?
Citizens'	158.16	14.02	172.18	....	....	....	172.18	276	78	26	12.3
Newburyport	569.81	72.36	642.17	472.85	....	472.85	1,115.02	900	475	170	29.2
North Adams	3,155.67	74.96	3,230.63	1,360.91	9.00	1,369.91	4,600.54	2,000	1,900	700	30.6
Vineyard	234.59	18.50	253.09	85.32	....	85.32	338.41	712	93 A. (214)[1]	24 A. (55)	19.3
Total	25,893.25	1,016.42	26,909.69	14,873.02	109.94	14,982.96	41,892.61	23,221	9,453 (14)	2,926	(14) 27.7
Average	1,523.13	59.79	....	....	6.47	881.35	2,464.27	1,366	675	173	29.2[2]

[1] Also given as 1,677 K.W.H.

[2] Weighted average.

COMPARATIVE CONNECTED LOADS (1911–1915)

Municipality	Connected load (K.W.)													
	Total		Commercial lighting		Street lighting		Power		Per customer				Per capita total	
									Light		Power			
	1911	1915	1911	1915	1911	1915	1911	1915	1911	1915	1911	1915	1911	1915
Braintree	?	?	?	?	29.75	47.72	80.00	130.00	?	?	2.31	4.48	?	?
Chicopee	?	?	?	?	87.32	101.11	(261.03)	? (873.00)[1]	?	?	(9.65)[2]	?	?	?
Concord	898.20	1,121.62	300.00	360.40	45.20	49.60	53.00	121.62	1.29	1.11	1.23	1.40	0.140	0.165
Danvers	1,028.63	2,206.24	305.05	636.90	83.58	95.46	140.00	1,573.88	0.92	0.45	3.11	20.71	0.109	0.206
Hudson	727.90	916.85	434.54	575.00	22.45	26.10	221.00	315.75	1.06	0.81	7.62	7.02	0.106	0.116
Hull	1,213.26	2,005.24	1,137.64	1,500.00	28.95	38.48	46.67	466.76	1.05	0.96	2.75	3.36	0.577	0.576
Ipswich	?	?	?	?	46.66	47.70	. .	....	?	?	....	....	?	?
Mansfield	?	?	?	?	23.00	24.40	269.00	367.00	?	?	6.97	7.06	?	?
Marblehead	?	?	?	?	73.75	66.15	188.00	321.00	?	?	4.48	5.73	?	?
Merrimac	211.14	272.72	77.60	93.44	19.04	16.60	114.50	162.68	0.85	0.53	14.31	14.79	0.096	0.130
North Attleborough	1,011.35	1,425.21	894.65	1,161.50	36.20	47.96	80.50	295.75	1.52	1.31	5.22	7.00	0.106	0.159
Peabody	1,898.63	2,573.25	1,306.12	1,440.80	90.51	58.20	502.00	1,074.45	1.42	1.12	8.06	8.60	0.121	0.130
Reading	914.30	1,782.76	745.90	1,521.69	71.06	71.76	96.90	189.33	0.91	1.01	2.36	3.44	0.157	0.154
Taunton	(2,375.02)	?	(1,011.45)	....	159.58	111.40	1,204.00	3,063.00	(1.68)	?	14.68	22.69	(0.089)	?
Holyoke	8,300.85	14,606.34	3,445.00	7,974.39	218.85	228.78	4,637.00	6,403.17	1.45	1.59	21.47	23.72	0.144	0.240
Middleborough	625.90	952.76	488.23	695.60	20.58	24.26	117.10	243.00	1.19	1.11	5.35	7.84	0.076	0.110
Wakefield	?	?	?	?	45.45	42.00	?	(110.41)	?	?	?	(3.45)	?	?
Westfield	?	?	?	?	76.66	93.83	215.00	946.00	?	?	2.48	8.23	?	?
Total – Holyoke out	8,529.40[3]	13,426.67	6,739.72	8,665.03	261.73	272.73	3,278.67	9,160.22	1.15	0.95	5.85	9.46	0.125	0.169
Average	947.70	1,491.85	748.86	962.78	56.67	57.22	218.57[5]	610.68[4]	....	....	....	(9.22)	....	....
Total — Holyoke in	16,830.25	28,032.01	10,184.72	16,639.42	1,180.58	1,201.51	7,915.67	15,563.39	1.23	1.18	10.20	13.67	0.136	0.209

[1] For 3 plants, Taunton out. [2] Average for 15 plants, Chicopee out. [3] In 1914. [4] Average for 15 plants, Wakefield out.

COMPARATIVE CONNECTED LOADS (1911–1915)

Company	Connected load (K.W.)													
	Total		Commercial lighting		Street lighting		Power		Per customer				Per capita	
									Light		Power			
	1911	1915	1911	1915	1911	1915	1911	1915	1911	1915	1911	1913	1911	1915
Amesbury	1,019.12	2,973.84	902.78	993.30	31.34	39.40	685.00	1,941.14	1.00	1.14	12.45	23.11	0.130	0.290
Attleboro	3,238.97	4,227.19	1,572.10	2,283.20	80.67	73.85	1,576.30	1,885.14	1.50	1.21	16.08	14.02	.173	.229
Buzzard's Bay	99.60	638.38	92.44	563.19	7.16	24.44	....	50.73	0.71	0.55	?	1.37	.032	.049
Gloucester	2,624.04	4,212.55	2,098.90	3,400.45	96.04	106.60	429.10	705.50	1.40	1.46	4.13	2.13	.092	.138
Great Barrington	1,103.95	1,675.61	760.65	786.21	14.80	19.25	328.50	870.15	1.55	1.04	8.10	8.45	.132	.184
Lee	477.20	836.60	463.00	582.00	74.20	52.48	3.70	245.00	1.43	1.34	1.23	7.66	.067	.108
Leominster	1,707.20	2,301.39	949.30	995.22	10.50	9.60	683.00	1,223.70	1.11	0.93	8.90	16.42	.090	.130
Northampton	2,109.60	3,209.39	1,254.10	2,010.46	159.50	63.05	696.00	1,135.88	1.30	1.36	2.63	7.56	.109	.142
Plymouth	2,101.50	3,615.41	1,316.55	1,707.05	20.95	30.00	764.00	1,878.36	1.56	0.96	7.96	11.32	.129	.187
Quincy	3,053.81	5,966.69	2,086.25	4,382.25	106.26	109.72	859.30	1,474.72	0.94	1.04	12.10	10.10	.094	.147
Weymouth	1,249.44	2,257.36	546.80	1,225.00	27.64	33.36	675.00	1,000.00	0.68	0.85	21.77	40.00	.067	.103
Winchendon	444.30	697.00	284.50	386.60	19.80	19.40	140.00	281.00	1.26	1.36	15.56	13.38	.078	.118
Beverly	2,560.55	3,065.08	2,196.80	2,515.09	153.90	246.43	209.85	303.56	1.88	1.38	4.20	4.86	.113	.113
Citizens'	151.90	172.13	133.00	158.16	18.90	14.02	....	....	0.57	0.45	....	....	.051	.054
Newburyport	853.35	1,115.02	418.74	569.61	71.16	72.36	364.05	472.85	1.28	1.01	7.58	9.27	.052	.061
North Adams	2,520.28	4,000.54	1,368.35	2,155.67	72.68	74.96	1,080.00	1,369.91	0.92	1.61	16.12	11.44	.109	.199
Vineyard	274.90	338.41	159.67	234.59	15.23	18.50	100.00	85.32	0.43	0.43	25.00	9.45	.121	.088
Total	25,580.96	41,392.62	16,008.93	25,893.25	983.38	1,016.42	8,563.80	14,982.96	1.21	1.13	7.76	9.74	0.108	0.147
Average	1,504.76	2,434.27	953.17	1,523.13	57.84	59.79	505.52	881.35	....	....	....	....	....	....

NUMBER OF KILOWATT HOURS CONSUMED PER KILOWATT CONNECTED LOAD

Municipality	Total [1]		Commercial lighting		Street lighting		Power	
	1911	1915	1911	1915	1911	1915	1911	1915
Braintree	?	?	?	?	5,622	3,007	429	346
Chicopee	?	?	?	?	3,922	3,862	(1,833)	(?)
Concord	511	610	304	376	3,400	3,845	1,193	1,113
Danvers	590	875	297	457	2,040	3,488	1,404	885
Hudson	515	491	261	282	3,057	3,532	862	622
Hull	213	225	176	187	1,424	2,004	366	203
Ipswich	?	?	?	?	?	3,000	....	....
Mansfield	?	?	?	?	4,242	3,562	307	396
Marblehead	?	?	?	?	5,732	4,228	264	375
Merrimac	906	570	244	311	1,978	2,255	1,144	547
North Attleborough	338	365	200	161	2,612	2,302	750	864
Peabody	457	664	176	225	3,502	4,857	636	1,025
Reading	504	363	230	230	3,200	3,140	564	696
Taunton	(906)	?	(392)	....	4,150	6,043	908	527
Holyoke	1,062	764	540	363	4,226	4,622	1,301	1,124
Middleborough	326	313	251	263	1,750	1,755	391	343
Wakefield	?	?	?	?	1,939	3,686	....	335
Westfield	?	?	?	?	4,000	4,378	1,172	800
Average — Holyoke out	443 [2]	525	229 [2]	262	3,440	3,783	784 [3]	674 [3]
Average — Holyoke in	748	658	334	305	3,681	3,946	1,087	859

[1] Sales to other plants deducted.

[2] Taunton out.

[3] Chicopee out.

NUMBER OF KILOWATT HOURS CONSUMED PER KILOWATT CONNECTED LOAD

Company	*Total* [1]		*Commercial lighting*		*Street lighting*		*Power*	
	1911	1915	1911	1915	1911	1915	1911	1915
Amesbury	632	294	382	170	2,713	2,496	770	313
Attleboro	696	545	279	238	2,340	2,814	1,028	825
Buzzard's Bay	?	837	?	785	1,434	1,951	....	647
Gloucester	318	281	213	168	2,707	2,755	299	451
Great Barrington	366	330	220	264	3,165	2,975	580	331
Lee	290	734	258	466	1,792	2,339	....	1,288
Leominster	591	832	228	297	2,743	3,382	860	1,129
Northampton	579	488	439	328	1,744	3,660	565	595
Plymouth	495	509	309	403	3,238	4,195	741	444
Quincy	429	378	235	199	4,716	4,561	361	509
Weymouth	447	473	363	409	2,574	2,548	443	495
Winchendon	417	738	484	343	2,404	3,147	?	811
Beverly	488	696	249	307	3,766	3,638	588	819
Citizens'	400	371	266	253	1,545	1,710	....	.....
Newburyport	988	910	388	383	3,276	4,441	1,116	1,005
North Adams	1,017	683	565	269	4,792	3,917	1,337	1,470
Vineyard	459	962	477	1,134	1,893	1,789	214 [2]	269 [2]
Average	573	511	306	289	3,061	3,437	770	699

[1] Sales to other plants deducted.

[2] Vineyard sells current to street railway.

Municipality	Motors				Number of commercial lamps of all kinds						No. of commercial arc lights	
	Total number		Average K.W. capacity		Total		Per consumer		Per capita			
	1910	1915	1911[3]	1915	1910	1915	1910	1915	1910	1915	1910	1915
Braintree	5	35	2.31	3.71	19,807	?	24.0	?	2.4	?	0	0
Chicopee	26	69[2]	11.80	9.75	13,968	?	18.0	?	0.6	?	12	0
Concord	17	49	3.31	2.48	18,000	19,006	26.0	22.1	2.8	2.8	0	0
Danvers	31	119	10.00	13.23	14,963	15,516	20.5	11.1	1.6	1.4	5	4
Hudson	42	62	4.51	5.09	9,545	14,375	22.2	20.2	1.4	1.8	1	0
Hull	6	117	1.84	3.12	18,329	32,000	23.0	19.0	8.7	14.0	6	0
Ipswich	....	....	....	....	5,448	?	22.0	?	0.9	?	0	0
Mansfield	22	52	11.21	7.06	4,690	?	17.5	?	0.9	?	0	0
Marblehead	46	104	3.69	3.09	18,465	?	18.0	?	2.5	?	1	1
Merrimac	19	33	6.03	4.93	1,504	2,210	20.3	12.6	0.7	1.1	0	0
North Attleborough	20	?	2.43	?	16,341	23,230	30.0	25.8	1.7	2.5	8	0
Peabody	57	123	4.19	8.74	14,510	29,721	17.0	22.2	0.9	1.5	10	5
Reading	18	78	2.69	2.43	14,822	23,235	22.5	15.5	2.5	2.0	5	0
Taunton	111	336	9.56	9.12	17,842	?	32.5	?	0.5	?	122	0
Holyoke	430	1,145	7.78	5.59	46,975	182,032	25.5	36.4	0.8	3.0	480	179
Middleborough	34	85	2.66	2.86	7,014	17,011	19.5	27.4	0.9	2.0	14	11
Wakefield	58	46	0.68	2.40	7,020	?	23.4	?	0.6	?	11	6
Westfield	98	185	3.18	5.11	5,939	?	25.6	?	0.4	?	28	2
Total — Holyoke out	610 (590)[1]	1,493	5.18	6.47	208,227 (115,028)[4]	176,306	22.2	19.3	1.16	2.22	223 (49)[5]	29 (20)[5]
Total — Holyoke in	1,040	2,638	6.46	6.09	255,202 (162,003)	358,338	22.9	25.4	1.08	2.55	703	208

[1] Excluding North Attleboro. [2] For 1914. [3] Correct data for 1910 cannot be secured.
[4] Including only those which reported at both dates. [5] Including only the 9 plants reporting all lamps at both dates.

Company	Motors				Number of commercial lamps of all kinds						No. of commercial arc lights	
	Total number		Average K. W. capacity		Total		Per consumer		Per capita			
	1910	1915	1911[1]	1915	1910	1915	1910	1915	1910	1915	1910	1915
Amesbury	80	171	6.30	11.35	5,063	24,778	19.3	23.5	0.5	2.4	11	5
Attleboro	225	325	6.57	5.80	26,450	44,686	31.6	23.9	1.4	2.4	142	87
Buzzard's Bay	....	41	....	1.24	755 (2,237)[2]	18,788	11.1	13.6	0.24 (0.7)[2]	0.9	0	0
Gloucester	120	181	3.04	3.90	33,064	75,001	24.4	32.1	1.2	2.5	54	1
Great Barrington	72	146	3.43	5.95	13,748	19,645	29.1	26.1	1.6	2.2	10	1
Lee	3	33	1.22	7.68	9,631	14,900	32.0	33.7	1.3	1.9	1	0
Leominster	118	203	5.17	6.35	13,671	19,434	17.5	18.7	0.7	1.1	41	11
Northampton	330	526	1.51	3.48	23,326	38,466	27.0	26.0	1.2	1.5	50	23
Plymouth	?	206	?	9.12(?)	15,173	34,121	26.8	19.2	1.1	1.8	9	3
Quincy	77	200	10.88	7.37	30,515	102,070	16.3	24.2	0.9	2.5	24	25
Weymouth	?	156	?	6.41	?	?	?	?	?	?	0	0
Winchendon	7	72	4.5	3.90	5,832	8,264	27.3	27.7	1.0	1.4	3	0
Beverly	61	89	3.38	3.41	26,050	62,559	36.2	33.3	1.8	2.3	68	33
Citizens'	....	....	....	....	2,600	3,554	11.7	10.2	0.9	1.1	0	0
Newburyport	59	107	4.55	4.42	7,320	23,469[4]	23.4	46.1[4]	0.45	1.5	6	9
North Adams	204	247	4.76	5.55	33,294	44,768	25.1	22.9	1.4	1.9	243	3
Vineyard	3	16	16.67	5.33	3,201	5,802	16.8	10.6	1.4	1.5	0	0
Total	1,418	2,518 (2,156)[3]	4.34	5.95	262,733	535,405	24.4	26.1	1.1	1.9	667	201

[1] Excluding Plymouth and Weymouth, which did not report in 1910.
[2] 1911.
[3] 1911 is taken to correspond with the group of municipal plants.
[4] 1914.

Municipality	Number of municipal street lights: Arcs		Incandescents: Total		Carbons		Tungstens		Total (June 30)		Average daily number of street lamps in use		Average number of hours in use per night		Average number of nights in use per month		Average wattage of street lamps		Number of renewals (incandescents)	
	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915
Braintree	98	0	270	697	0	0	270	697	368	697	360	692	7.8	8.5	28.2	28.8	170	66	265	740
Chicopee	226	251	39	187	0	0	39	187	265	438	260	443	10.6	10.4	30.4	30.4	279	216	10	?
Concord	0	0	863	992	0	0	863	992	863	992	856	983	9.3	10.6	30.4	30.4	50	50	1,583	920
Danvers	127	53	223	743	10	0	252	743	389	796	263	796	7.0	8.5	27.8	29.8	215	120	?	?
Hudson	19	2	278	425	60	0	218	425	297	437[a]	277	434	6.0	8.0	29.0	30.4	80	60	221	519
Hull	0	0	527	651	527[b]	0	0	651	527	651	395	515	5.6	7.9	26.9	30.3	67	60	850	1,114
Ipswich	0	14	796	790	796	490	0	300	796	804	784	804	9.9	8.4	25.8	30.4	56	59	760	475
Mansfield	0	0	407	447	0	0	407	447	407	447	402	442	10.9	10.5	30.3	30.4	56	55	646	?
Marblehead	164	159	122	265	82	0	40	265	286	424	274	420	9.4	11.1	30.2	30.4	230	156	?	657
Merrimac	0	0	321	390	310	25	11	365	321	390	321	386	5.5	5.6	27.5	28.6	56	43	374	1,074
North Attleborough	0	0	711	794	0	0	711	794	711	794	705	785	5.8	6.6	27 9	29.1	47	60	445	1,088
Peabody	182	75	166	713	3	0	163	713	348	788[c]	273	770	10.0	10.5	30.0	30.4	231	74	320	397
Reading	139	0	20	490	0	0	20	490	159	490[d]	145	468	10.4	10.2	30.4	30.4	444	102	14	656
Taunton	238	122[e]	1,013	1,473	0	0	1,013	1,473	1,249	1,595	1,182	1,594	10.7	10.8	30.3	30.4	137	70	995	2,218
Holyoke	532	442	61	519	35	33	26	486	593	961	582	929	10.6	10.9	30.4	30.4	455	238	51	891
Middleborough	26	13	193	220	11	0	182	220	218	243	211	236	4.6	5.3	25.0	26.2	97	100	65	139
Wakefield	43	0	412	576	0	0	412	576	455	576	454	556	5.7	8.1	26.2	29.0	161	73	510	1,022
Westfield	131	149	29	247	0	0	29	247	160	396	148	383	10.6	10.7	30.4	30.4	448	237	164	?
Total — Holyoke out	1,396	868	6,523	10,120	1,739	515	4,729	9,605	7,924	10,988[f]	7,490	10,727[g]	8.6	9.1	28.7	30.0[h]	130	87	(7,113)	(11,008)
									466	646	427	631								
Total — Holyoke in	1,928	1,310	6,589	10,639	1,834	548	4,755	10,091	8,517	11,949	8,019	11,656	8.6	9.3	....	....	152	99	....	....

[a] 15 at close of year. [b] Metallised carbon. [c] Other towns out; total, 696. [d] Other towns out; total, 514. [e] Holyoke in.

Company	Number of municipal street lights: Area		Incandescents: Total		Carbons		Tungstens		Total (June 30)		Average daily number of street lamps in use		Average number of hours in use per night		Average number of nights in use per month		Average wattage of street lamps		Number of renewals (incandescents)	
	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915
Amesbury	35	32	322	455	0	0	322	455	357	487	357	455	6.4	6.4	26.0	27.7	81	81	332	413
Attleboro	119	26	406	989	20	0	386	989	525	1,015	486	929	6.4	6.9	28.6	29.8	158	73	386	1,440
Buzzard's Bay	0	0	24 (231)[1]	861	0	0	24 (231)[1]	861	24 (231)	861	23 (189)[1]	743	8.0 (5.2)[1]	6.8	27.1 (28.2)[1]	28.0	31	40	8	631
Gloucester	110	112	1,020	1,406	0	0	1,020	1,406	1,130[4]	1,518	1,030	1,352	6.1	7.6	26.3	28.4	76	70	1,361	1,825
Great Barrington	0	6	248	343	45	0	203	343	248	349	247	342	10.3	9.4	30.4	30.2	59	55	505	356
Lee	0	0	199	240	90	0	109	240	199	240	198	240	6.2	5.7	26.9	28.1	45	40	351	417
Leominster	115	0	220	946	12	0	208	946	335	946	261	926	5.7	7.3	29.8	30.4	220	55	598	1,343
Northampton	115	15	360	942	360	(?)83	0	859[2]	475	960	467	869	6.5	6.9	30.4	30.4	234	66	420	1,210
Plymouth	8	0	365	600	0	0	365	600	373	600	371	588	4.4	10 1	29.3	29.9	58	50	160	573
Quincy	170	185	820	1,103	0	0	820	1,103	990	1,288	957	1,252	7.2	10.9	29.8	30.4	106	85	1,358	2,574
Weymouth	32	0	357	704	0	0	357	704	389	704	376	680	5.6	6.2	25.8	28.7	78	46	995	1,178
Winchendon	20	12	163	250	115	0	47	250	183	263	176	255	5.0	6.2	26.2	30.4	112	74	122	143
Beverly	360	424	28	806	0	0	28	805	394	1,230	372	1,197	10.1	9.2	30.3	30.4	330	200	0	334
Citizens'	29	0	108	159	68	10	40	149[3]	137	159	130	149	4.8	4.8	25.6	25.8	140	88	40	97
Newburyport	173	176	34	49	34	0	0	49	197	225	193	223	5.9	9.3	26.5	30.4	367	322	7	61
North Adams	210	221	45	67	0	0	45	67	255	296	255	295	10.7	10.8	30.4	30.4	441	252	28	111
Vineyard	19	0	177	368	157	0	20	368	196	368	161	298	4.5	7.3	27.0	28.7	73	50	106	377
Total	1,524	1,235	4,585	10,988	891	93	3,974	10,195	6,400 877	11,511 877	6,247 867	10,783 634	6.5	7.6	27.4	29.7	150	86	6,761	13,369

[1] 1911. [2] Including 88 nitrogen lamps. [3] Including 31 nitrogen lamps.

STREET LIGHTING DATA (*concluded*)

Municipality	*Number of inhabitants served by one lamp* [1]		*Total C.P. illumination on streets*		*Per capita C.P. illumination*		*Number K.W.H. used for street lighting per capita*	
	1910	1915	1910	1915	1910	1915	1910	1915
Braintree	21.9	13.4	128,560	38,800	15.9	4.2	20.3	15.3
Chicopee	96.0	64.4	271,120	331,200	10.6	11.0	13.4	13.0
Concord	7.4	6.7	34,240	49,150	5.4	7.3	23.7	28.5
Danvers	24.0	14.0	173,244	127,200	18.4	11.5	15.3	30.0
Hudson	22.4	15.5	36,275	26,320 [3]	5.4	4.0	9.4	13.7
Hull	4.0	3.6	12,640	25,388	6.0	11.0	17.8	33.9
Ipswich	7.2	7.8	12,544	41,380	2.2	6.6	25.4	22.7
Mansfield	12.6	12.8	18,072	19,352	3.5	3.4	19.3	15.4
Marblehead	25.3	18.0	182,565	199,422(?)	26.0	26.0	26.1	36.7
Merrimac	7.0	5.4	5,290	12,190	2.4	5.3	15.9	17.9
North Attleborough	13.4	11.9	26,552	40,008	2.8	4.3	9.4	11.3
Peabody	45.0	23.6	228,272	80,696 [3]	14.5	4.5	18.3	14.7
Reading	36.4	13.9	165,380	42,600 [3]	28.6	5.3	39.1	23.1
Taunton	27.4	22.6	345,380	255,607	10.0	7.0	19.0	18.6
Holyoke	10.0	6.3	637,490	228,412(?) (579,312)	10.3	3.3 (9.7)	15.4	17.4
Middleborough	37.3	34.0	36,319	32,300	4.5	3.3	5.0	5.0
Wakefield	25.0	22.5	73,340	51,303	6.7	4.0	7.3	12.1
Westfield	100.0	46.0	255,260(?)	197,520(?)	16.0	11.0	19.5	22.4
Average — Holyoke out	22.7	18.1	2,007,053	1,570,436	11.0	8.0	17.1	18.1
Average — Holyoke in	27.9	21.7	118,062 [2] 2,644,543	92,380 [2] 1,798,848	11.0	7.0	16.7	17.9

[1] Based on total number of lamps.

[2] Average.

[3] Lamps in other towns omitted. (Cf. *supra*.)

STREET LIGHTING DATA (*concluded*)

Company	Number of inhabitants served by one lamp [1]		Total C.P. illumination on streets		Per capita C.P. illumination		Number K.W.H. used for street lights per capita		Cost of street lighting per capita (dollars)	
	1910	1915	1910	1915 (*Estimated*)	1910	1915	1910	1915	1910	[redacted]
Amesbury	27.7	25.1	52,304	56,180	5.3	5.5	7.7	9.6	$0.91	$0.95
Attleboro	40.0	20.0	148,560	70,072	3.0	3.3	9.4	11.2	0.79	0.95
Buzzard's Bay	136.7 (13.6) [2]	17.7	4,736	23,776	1.5	1.5	3.3 [2]	4.4(?)	0.05 0.78	0.76(?)
Gloucester	27.6	22.6	158,986	174,080	5 6	5.7	7.3	9.6	0.76	0.86
Great Barrington	33.7	26.0	2,560	24,080	1.1	2.6	2.1	6.3	0.55	0.59
Lee	36.0	32.2	4,928	7,680	0.7	1.0	2.5	2.9	0.67	0.38
Leominster	72.7	19.1	144,162	42,300	7.6	2.4	10.6	10.6	0.49	0.57
Northampton	41.6	24.9	152,080	59,680	7.9	2.5	13.9	10 7	0.62	0.72
Plymouth	32.7	32.6	24,120	23,520 (89,644)	2.0	1.2	5.6	6.5	0.67	0.51
Quincy	34.1	32.5	238,016	145,144	7.0	3.6	10.4	12.3	0.74	0.81
Weymouth	34.3	21.2	50,576	25,044	4.0	1.3	5.7	5.9	0.63	0.79
Winchendon	31.2	23.5	26,355	28,500	4.6	4.8	8.5	10.3	0.65	0.80
Beverly	53.3	22.6	413,920	532,940	20.9	19.7	26.9	33.1	1.52	1.91
Citizens'	21.8	21.2	34,768	16,448	11.7	5.2	9.1	7.6	1.16	1.26
Newburyport	77.5	82.2	205,904	212,704	13.8	11.6	8.6	17.5	0.90	0.90
North Adams	86.3	78.5	421,800	374,560	19.2	16.2	15.8 [2]	12.7	0.85	0.98
Vineyard	5.9	12.9	13,992	13,460	13.0	5.5	8.3	8.6	1.92	1.51
Average	37.2	24.8	2,064,656 123,215	1,530,148 107,656	9.0	6.4	11.0	12.2	$0.82	$0.93

[1] Based on total number of lamps.

[2] Figures for 1911.

Municipality	Total length of wire (feet)		Length of streets with overhead wires (feet)		Length of street lighting lines (feet)		Length of commercial lines per customer (feet)		Length of street lighting lines per capita (feet)		Number of poles		Transformers			
													Number		Customers per transformer	
	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915
Braintree	666,191	872,129	147,100	182,000	221,300	248,210	537	444	27	27	1,576	1,817	27	42	30.7	38.5
Chicopee	757,515	1,273,806	185,044	[1]	291,174	472,246	601	449	11	16	894	1,406	241	320	3.2	5.6
Concord	1,033,513	1,188,821	230,700	282,170	411,883	432,768	330	380	64	65	1,722	1,967	92	106	7.8	8.0
Danvers	514,149	921,410	199,650	291,500	231,940	308,640	525	436	25	28	1,002	1,418	121	123	6.0	11.4
Hudson	436,992	791,287	101,000	151,110	134,692	227,987	593	791	20	29	902	1,102	66	123	6.6	6.7
Hull	631,192	913,907	126,801	162,971	204,968	276,181	535	380	97	121	1,319	1,604	117	134	6.8	12.5
Ipswich	441,175	487,005	115,750	124,980	336,073	363,255	429	247	58	58	980	1,061	62	111	3.0	4.5
Mansfield	307,125	458,720	112,900	119,580	187,185	244,880	443	373	36	42	390	524	58	57	4.7	10.0
Marblehead	603,579	875,601	167,375	175,135	221,416	344,446	373	456	20	32	1,221	1,294	180	228	5.7	6.1
Merrimac	177,320	309,053	42,960	64,732	120,960	172,500	672	780	55	69	416	567	42	70	1.8	2.5
North Attleborough	728,825	904,393	125,895	153,297	231,120	267,400	907	715	24	28	1,446	671	107	94	5.1	9.5
Peabody	783,100	1,314,600	165,000	275,700	315,800	519,200	547	566	20	26	1,050	1,518	178	258	4.8	5.4
Reading	537,019	1,539,350	148,485	439,787	170,853	587,253	550	627	22	51	1,339	3,425	102	218	6.5	7.0
Taunton	1,018,676	1,887,950	433,520	530,000	633,670	616,910	764	855	18	28	1,835	2,290	286	443	2.0	2.8
Holyoke	1,141,975	1,634,319	200,437	254,909	379,976	433,651	404	293	7	7	2,235	2,858	274	355	6.9	14.2
Middleborough	291,349	515,585	117,969	178,305	123,349	182,940	499	532	15	21	209	119	70	135	5.2	4.6
Wakefield	478,943	727,608	179,301	197,391	278,676	320,724	626	527	25	26	993	1,136	62	211	5.2	3.6
Westfield	294,627	644,338	98,956	176,815	160,896	255,091	469	343	10	14	713	1,147	100	161	2.9	7.0
Total—Holyoke out.	9,771,290	15,626,124	2,713,306	3,475,433	4,282,172	5,940,631	576	536	23	29	17,906	23,040	1,951	2,841	4.9	6.4
Total (miles)	1,851	2,960[2]	514[2]	658	811	1,125	....	....	....	....	....	....	....	....	....	....
Average	109.0[2]	174.1[2]	(17)30.2[2]	(16)41.1[2]	47.7[2]	66.2[2]	....	....	....	....	1,053	1,355	115	167	....	....
Total—Holyoke in	10,913,285	17,260,443	2,913,745	3,730,392	4,662,148	6,374,282	549	471	19	24	20,141	25,846	2,225	3,180	5.1	7.3

[1] In miles.

[2] Chicopee out, 2,720 miles.

[3] Chicopee out, 479 miles.

Company	Total length of wire (feet)		Length of streets with overhead wires (feet)		Length of street lighting lines (feet)		Length of commercial lines per customer (feet)		Length of street lighting lines per capita (feet)		Number of poles		Transformers: Number		Transformers: Customers per transformer	
	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915
Amesbury	412,751	1,217,001	142,240	290,613	247,964	406,233	601	906	25	40	1,322	2,119	103	199	2.7	4.5
Attleboro	862,962	1,395,613	241,248	309,914	395,172	440,595	557	472	21	24	1,416	2,758	267	382	3.1	4.9
Buzzard's Bay	88,843	1,949,390	20,350	334,160	31,008	412,761	777	1,514	10	27	76	3,873	11	144	6.2	7.0
Gloucester	1,132,200	1,732,428	95,200	103,253	511,000	777,000	379	392	21	25	3,734	4,753	393	560	3.5	4.5
Great Barrington	805,393	1,474,915	194,000	318,819	139,465	193,457	1,390	1,686	17	21	1,256	2,370	174	294	2.8	2.6
Lee	473,961	622,011	116,464	151,396	183,919	231,850	964	883	26	30	931	1,293	124	96	2.4	4.8
Leominster	725,570	1,227,508	148,000	238,430	304,950	454,725	512	693	16	26	1,430	2,881	191	163	4.3	6.8
Northampton	751,600[1]	1,582,848	187,425	265,358	445,210	612,900	349[2]	647	23	28	1,747	3,341	133	203	6.6	8.0
Plymouth	751,228	1,634,300	238,560	695,209	193,296	293,204	787	849	16	15	1,500	2,436	152	243	4.7	7.5
Quincy	1,801,000	2,383,000	448,200	557,000	735,000	920,000	561	332	23	23	3,062	5,843	208	313	6.3	13.6
Weymouth	804,342	2,067,737	280,464	457,197	360,341	498,464	896	1,084	27	36	1,505	2,642	63	145	9.7	10.0
Winchendon	322,645	376,565	92,051	104,121	124,894	151,496	911	745	24	26	791	900	45	70	4.8	4.3
Beverly	1,591,709	3,737,877	380,640	554,980	537,510	969,283	1,054	921	27	37	3,193	4,472	366	409	2.7	4.6
Citizens'	196,265	242,400	74,600	77,200	68,574	77,598	583	474	23	26	748	772	45	47	5.0	7.4
Newburyport	300,200	408,600	143,650	211,600	159,300	160,000	620	435	11	9	537	698	152	191	2.1	3.0
North Adams	936,280	1,147,411	160,800	176,432	281,920	300,022	488	409	13	13	1,840	2,135	165	210	8.1	9.9
Vineyard	167,430	634,363	71,510	146,076	87,400	135,887	575	518	53	48	736	1,577	41	58	4.7	9.5
Total	12,271,379[3]	22,994,537[4]	3,035,502[5]	5,018,407[6]	4,888,213	7,103,551	640	678	21	26	25,632	45,143	2,630	3,727	4.4	6.3
Total (miles)	2,324	4,355	575	950	926	1,345	(639)[7]	(626)[7]	....	....	....	....	....	....	....	....
Average	136.7[3]	268.1[4]	33.8[5]	55.9[6]	54.5[3]	79.1[4]	....	....	....	....	1,507	2,655	155	219	....	....

[1] Only primary wire recorded.
[2] Includes 647,027 feet of underground cable, of which 473,289 are in Beverly and 152,938 in Gloucester.
[3] Includes 109,726 feet of conduits.
[4] Includes 22,020 feet of underground cable, of which 4,110 are in Beverly, and 15,100 in Gloucester.
[5] No secondary lines returned.
[6] Includes 18,659 feet of conduits.
[7] Buzzard's Bay out.
[8] In miles.

Municipality	Number	Total capacity (K.W.)	Average size (K.W.)	Number of transformers of certain sizes				
				1 K.W. or less	2 + 3 K.W.	5 + 5 K.W.	5 + 10 K.W.	Over 10 K.W.
Braintree	42	508	12.0	0	0	19	2	21
Chicopee	320	1,969	6.1	93	127	53	17	46
Concord	106	398	3.7	45	24	13	14	4
Danvers	123	1,488	12.1	22	25	25	24	27
Holyoke	355	9,397	26.5	17	47	51	44	196
Hudson	128	642	5.0	42	33	13	22	12
Hull	134	992	7.4	13	35	27	33	27
Ipswich	(111)	?	?	?	?	?	?	?
Mansfield	57	461	8.1	1	14	20	12	10
Marblehead	226	520	2.3	53	67	47	45	16
Merrimac	70	292	4.2	15	27	16	8	4
Middleborough	135	532	4.0	20	69	16	27	3
North Attleborough	94	596	6.3	13	28	14	27	12
Peabody	258	2,128	8.2	67	73	32	32	54
Reading	218	809	3.6	55	103	39	12	9
Taunton	443	3,215	7.1	140	112	58	43	95
Wakefield	211	696	3.3	121	45	21	16	7
Westfield	161	1,166	7.2	36	22	39	50	17
Total — Holyoke out	2,730	16,375	6.00	736	512	423	384	364
Total — Holyoke in	3,065	25,772	8.35	755	559	453	428	559
Percentage of different sizes (Holyoke out)				27.0	20.0	15.6	14.1	13.3

Company	Number	Total capacity (K.W.)	Average size (K.W.)	Number of transformers of certain sizes				
				1 K.W. or less	2 + 3 K.W.	5 + 5 K.W.	5 + 10 K.W.	Over 10 K.W.
Amesbury	199	903	4.5	69	57	24	26	23
Attleboro	382	2,544	6.7	111	148	41	23	55
Beverly	409	1,495	3.7	135	131	76	50	15
Buzzard's Bay	144	518	3.6	10	78	51	8	0
Citizens'	47	194	4.1	9	22	7	5	4
Gloucester	560	1,943	3.5	208	203	83	45	23
Great Barrington	294	1,177	4.0	104	93	42	23	32
Lee	96	279	3.0	24	51	15	1	5
Leominster	153	1,207	7.8	28	51	31	14	29
Newburyport	191	1,227	6.4	20	56	48	43	24
North Adams	210	2,265	10.8	21	57	43	32	57
Northampton	208	1,655	8.2	14	58	42	40	49
Plymouth	243	2,633	10.8	26	51	40	34	32
Quincy	313	3,501	11.5	1	130	64	73	45
Vineyard	58	227	4.0	11	21	23	2	1
Weymouth	145	1,544	10.6	26	13	45	14	37
Winchendon	70	510	7.3	12	17	12	13	11
Total	3,727	24,021	6.45	880	1,222	680	454	453
Percentage of different sizes				24.1	33.0	18.5	12.2	12.1

Municipality	*Net land area (sq. m.)*	*Length of roads (miles)*	*Company*	*Net land area (sq. m.)*	*Length of roads (miles)*
Braintree	13.70	50.00	Amesbury	28.39	105.40
Chicopee	22.91	79.80	Attleboro	27.51	90.00
Concord	24.96	87.83	Buzzard's Bay	209.83	616.00
Danvers	13.64	90.00	Gloucester	47.38	168.80
Hudson	29.34	88.00	Great Barrington	112.05	218.00
Hull	2.43	25.70	Lee	47.99	75.00
Ipswich	33.22	60.00	Leominster	37.10	99.44
Mansfield	20.23	65.00	Northampton	35.63	180.25
Marblehead	4.40	34.00	Plymouth	278.79	415.00
Merrimac	8.66	35.00	Quincy	16.52	165.00
North Attleborough	19.05	91.70	Weymouth	16.56	75.00
Peabody	26.67	74.00	Winchendon	42.53	120.00
Reading	40.15	136.75			
Taunton	47.29	149.00	Beverly	50.35	171.90
			Citizens'	49.42	114.00
Holyoke	21.16	120.40	Newburyport	46.20	155.00
Middleborough	60.99	196.00	North Adams	43.29	82.41
Wakefield	7.35	48.00	Vineyard	41.13	75.35
Westfield	46.85	182.00			
Total — Holyoke out	421.84	1,412.78	Total	1,001.98	2,926.05
Average	24.81 [1]	83.10 [2]	Average	58.94	172.12
				(30.67) [3]	(105.50) [3]
Total — Holyoke in	443.00	1,533.18			

[1] Excluding foreign districts, 21.39.

[2] Excluding foreign districts, 74.06.

[3] Foreign districts excluded.

Municipality	Population		Investment in plant		Valuation of estates in districts served		Tax rate (per $1,000) [1]		Number of taxpayers resident and non-resident [1]	
	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915
Braintree	8,066	9,343	$147,454	$187,442	$6,265,880	$9,437,290	$20.40	$18.80	1,931	2,412
Chicopee	25,401	30,138	196,566	314,941	13,309,690	20,370,890	19.50	19.50	3,076	4,220
Concord	6,421	6,681	130,861	171,514	7,319,263	9,318,055	14.30	16.60	1,156	1,379
Danvers	9,407	11,177	121,098	168,520	6,470,425	8,580,175	19.20	20.40	1,884	2,285
Hudson	6,743	7,885	84,958	99,520	3,843,615	5,755,882	20.70	23.30	1,242	1,387
Hull	2,109	2,290	162,801	197,597	7,018,860	9,213,628	15.25	17.30	1,621	2,176
Ipswich	5,777	6,272	51,472	77,511	4,785,508	5,624,117	16.00	20.50	1,279	1,272
Mansfield	5,153	5,772	84,443	110,389	4,279,139	4,511,485	16.80	21.90	1,280	1,485
Marblehead	7,338	7,506	176,906	192,071	8,765,944	11,277,306	22.00	22.00	1,843	2,120
Merrimac	2,203	2,101	20,653	23,076	1,327,314	1,391,506	22.80	24.00	791	843
North Attleborough	9,562	9,396	135,428	136,309	7,732,240	9,559,990	20.00	22.60	1,515	2,136
Peabody	15,721	19,737	174,017	198,226	11,091,050	16,456,726	20.80	21.60	2,606	3,159
Reading	5,819	11,536	122,927	233,836	5,896,884	12,341,773	19.70	20.50	1,731	2,095
Taunton	34,259	36,161	336,767	449,494	22,780,761	26,274,584	19.50	21.20	4,977	6,045
Holyoke	57,730	60,516	686,404	1,223,957	49,852,240	65,215,053	17.00	18.80	3,968	4,754
Middleborough	8,214	8,631	126,351	113,649	4,644,205	4,956,205	20.80	22.40	1,531	1,908
Wakefield	11,404	12,781	101,571	116,518	9,380,540	12,292,792	20.50	25.20	2,519	2,950
Westfield	16,044	18,411	113,744	170,173	9,459,099	13,780,972	16.70	19.80	2,516	3,154
Total—Holyoke out	179,463	205,923 [2]	$2,336,897	$2,972,395	$134,330,987	$180,042,335	....	....	33,842	41,216
Average	10,568	12,113	137,461	171,990	7,901,823	10,590,764	....	....	1,991	2,424
Total—Holyoke in	236,508	266,739	3,223,241	4,147,762	184,183,227	245,257,388	....	....	37,810	45,960
Average	13,250	14,819	179,069	230,432	....	....	$19.00	$20.97	2,101	2,554

[1] Includes 5,851 in foreign districts.

[2] In places where plants are located.

Company	Population		Investment in plant		Valuation of estates in districts served		Tax rate (per $1,000)[4]		Number of taxpayers resident and non-resident[5]	
	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915
Amesbury	9,394	10,260	$182,169	$280,000	$8,247,477	$8,321,592	$18.00	$23.50	1,862	2,044
Attleboro	18,612	18,480	265,000	345,000	18,261,896	22,344,695	16.50	19.20	3,256	4,005
Buzzard's Bay	3,144	15,263	33,914	244,130	8,751,671	26,361,406	10.20	10.80	1,532	1,871
Gloucester	28,609	30,500	347,009	369,130	27,166,163	31,637,169	18.40	21.60	4,772	5,165
Great Barrington	8,349	9,068	147,982	182,744	7,487,344	8,667,542	12.30	13.70	1,263	1,389
Lee	7,165	7,728	66,200	69,965	8,935,685	11,296,473	22.80	22.20	905	906
Leominster	16,973	17,646	239,008	317,000	13,557,564	13,763,085	19.50	20.00	3,206	3,729
Northampton	19,431	21,652	207,722	274,259	14,754,111	18,795,551	16.50	22.20	3,342	3,617
Plymouth	16,274	19,152	223,231	402,499	15,190,026	22,533,751	18.80	18.00	2,915	3,342
Quincy	32,642	40,674	373,800	473,427[3]	32,456,380	43,606,515	20.00	22.00	7,934	10,314
Weymouth	12,895	13,959	205,476	532,000	7,929,074	12,802,614	23.00	19.40	3,374	4,172
Winchendon	5,678	5,908	137,351	160,940	4,184,305	4,398,560	23.00	22.00	1,107	1,207
Beverly	22,566	27,079	243,145	671,551[3]	43,814,617	58,662,550	15.20	16.20	3,120	4,169
Citizens'	2,969	3,166	34,716	42,100	3,528,780	4,626,305	17.00	17.00	(1,831)	(2,513)
Newburyport	16,451	18,230	208,187	254,561	16,505,677	15,253,845	17.50	21.00	2,868	2,977
North Adams	22,226	23,149	272,040	358,975	16,729,981	16,853,456	18.80	20.40	2,388	2,577
Vineyard	2,220	3,845	43,160	135,914	3,424,211	5,572,346	20.00	21.00	1,404	1,345
Total	249,143	295,880[4]	$3,190,139	$5,284,275	$243,925,146	$335,998,488	....	....	45,316	52,837
Average	14,656	16,817	187,067	310,840	14,642,956	19,784,617	$18.08	$19.42	2,668	2,900

[1] Including 41,869 in foreign districts.
[2] In places where plants are located.
[3] Investments out.
[4] Foreign districts out.
[5] Office building out, $65,567, for electric department.

Municipality	*Plant account (depreciated)*	*Gross plant cost (construction account)*	*Bonds outstanding*	*Notes outstanding*	*Total appropriations from tax levy for construction, note and bond payments, and sinking fund*	*Sinking fund payments (1914–1915)*	*Note payments (1914–1915)*	*New construction (1914–1915)*[1]
Braintree	$86,264	$95,840	$16,500	....	$147,902	$430	....	$2,037
Chicopee	263,991	340,777	141,000	$12,000	149,859	....	$8,000	4,365
Concord	94,639	171,514	116,000	38,580	50,196	2,680	1,500	1,729
Danvers	142,700	168,835	77,400	12,000	96,393	8,000	1,500	3,969
Hudson	65,906	98,793	8,000	22,300	67,020	....	3,400	750
Hull	115,312	189,045	....	56,502	137,109	1,600	3,000	5,455
Ipswich	76,983	78,922	....	64,300	14,961	....	2,150	835
Mansfield	100,955	132,310	90,500	....	22,856	1,000	2,000	3,657
Marblehead	127,997	192,071	70,000	....	99,215	1,000	3,000	2,682
Merrimac	25,155	25,567	6,000	2,400	11,548	....	1,800	726
North Attleborough	95,973	135,287	50,000	20,780	76,718	1,500	2,695	?
Peabody	148,546	176,873	82,000	....	131,626	800	2,000	1,635
Reading	169,728	214,536	83,000	82,500	200,908	....	9,000	13,838
Taunton	386,969	578,359	410,000	....	123,038	7,000	2,000	29,619
Total (14 plants)	$1,901,118	$2,598,719	$1,140,200	$261,282	$1,329,349	$24,010	$41,945	....
Holyoke	996,466	1,223,957	535,680[2]	....	(81,200)[3]	....	24,874[2]	131,451
Middleborough	66,719	113,649	21,760[2]	13,568[2]	(102,692)[3]	....	3,220[2]	2,076
Wakefield	80,044	76,295	42,000[2]	3,360[2]	(179,661)[3]	586[2]	5,642[2]	496
Westfield	146,595	170,143	68,850[2]	....	(46,441)[3]	....	4,890[2]	6,229
Total — Holyoke out	$2,194,476	$2,958,806	$1,283,010	$278,210	....	$24,596	$55,797	$80,098
Total — Holyoke in	3,199,942	4,182,763	1,818,690	....	....	....	80,671	211,549

[1] Not including payments from depreciation fund.

[2] Computed in accordance with the proportion which the electric plant cost bears to the combined cost of gas and electric plants. These are respectively, 53.4, 64.0, 41.8, and 51.0 per cent.

[3] Total. Cannot well be separated.

Company	Assessed valuation	Book value	Capital and loans [2]	Stock	Premiums on capital stock	Bonds	Notes	Net additions to plant (1914–1915)
Amesbury	$151,000	$254,069	$280,000	$235,000	....	....	$45,000	$27,697
Attleboro	341,450	331,470	345,000	275,000	$20,000	$30,000	20,000	(−508)
Buzzard's Bay	92,000	233,280	244,180	11,000	....	214,468	18,712	43,712
Gloucester	428,100	539,130	396,040	314,200	33,840	48,000	....	20,756
Great Barrington	90,000	182,744	136,500	125,000	....	30,000	11,500	14,617
Lee	17,080	69,465	67,200	30,000	....	70,000	7,200	(−919)
Leominster	283,055	309,158	317,000	220,000	....	78,000	27,000	2,411
Northampton	255,000	274,259	229,400	117,400	....	60,000	34,000	7,297
Plymouth	207,400	398,907	402,499	180,000	....	100,000	162,499	63,552
Quincy	448,425	479,649	476,245	300,000	26,245	....	50,000	22,038
Weymouth	382,640	475,315	532,000	300,000	15,000	....	217,000	26,505
Winchendon	30,000	160,940	137,900	12,000	....	5,000	120,900	2,340
Total (12 plants)	$2,726,150	$3,708,386	$3,563,964	$2,119,600	$95,085	$630,468	$713,811	....
Beverly	(1,312,026)[1]	671,581	604,795[3]	(687,500)[1] 398,800[3]	(355,250)[1] 206,045[3]	....	....	(−17,212)
Citizens'	32,930	40,558	42,100[3]	(26,000)[1] 15,900[3]	....	(25,500)[1] 15,325[3]	(17,350)[1]	5,620
Newburyport	(397,900)[1]	254,561	212,712[3]	(285,000)[1] 169,600[3]	....	....	(72,500)[1]	3,542
North Adams	(629,675)[1]	355,722	365,100[3]	(400,000)[1] 240,000[3]	(90,000)[1] 54,000[3]	....	(118,500)[1]	33,184
Vineyard	53,040	119,858	135,914[3]	(25,000)[1] 20,700[3]	....	....	(300)[1]	12,713
Total	....	$5,150,657	$4,924,585	$2,964,600	$455,130(?)	....	....	$267,345

[1] Gas and electric plant combined.

[2] Including premiums.

[3] Computed in accordance with the proportion which the electric plant cost bears to the combined cost of gas and electric plants. These are respectively, 58.0, 61.3, 59.5, 60.0, and 82.3 per cent.

Municipality	Total investment: Per K.W. capacity of dynamos		Per K.W. connected load	Per customer		Per capita		Per K.W.H. delivered (cents)		Per dollar of operating income		Station investment: Total amount		Per K.W. capacity of dynamos	
	1910	1915	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915
Braintree	$288	$306	?	$180	$112	$15.93	$17.00	42.	35.	$6.50	$6.00	$66,677	$85,997	$67	$70
Chicopee	190	210	?	292	175	7.86	10.50	16.	26.	5.80	5.40	194,182	223,980	113	149
Concord	374	166	$153	184	200	20.45	25.00	30.	25.	4.85	4.40	49,261	74,100	141	74
Danvers	253	141	73	166	119	13.00	14.00	21.—	8.5	4.25	3.10	62,456	82,071	130	68
Hudson	190	152	109	193	140	12.70	12.60	23.	22.	3.90	4.10	28,594	56,599	63	87
Hull	214	207	99	203	116	77.40	95.90	61.	44.	5.90	4.10	41,599	91,709	55	92
Ipswich	286	204	?	206	155	9.00	12.30	28.	25.	5.25	4.10	13,628	33,605	77	88
Mansfield	248	221	?	313	194	16.20	19.00	29.	30.	5.10	4.80	53,330	88,127	169	176
Marblehead	440	320	?	175	138	24.00	25.00	35.	28.	5.85	5.10	87,671	98,409	219	164
Merrimac	106	118	65	275	132	9.40	11.00	10.	14.	2.25	2.90	8,206	7,930	43	40
North Attleborough	222	223	91	250	151	14.10	14.50	48.	25.	5.00	4.40	86,218	94,757	144	139
Peabody	178	196	75	206	138	10 90	9.60	32.	11.	5.40	2.95	96,325	99,269	90—	102
Reading	246	234	130	183	155	21.20	20.30	24.	24.	5.10	4.80	59,637	85,981	120	86
Taunton	158	111	?	276	260	11.25	12.45	20.	15.	5.30	4.50	289,971	366,078	119	90
Holyoke	189	112	82	456	245	15.30	20.10	11.—	11.—	4.70	4.30	(?)542,781	529,258	(?)180	75
Middleborough	361	325	120	350	180	15.40	13.20	66.	33.	7.20	4.10	84,017	80,197	240	229
Wakefield	(506)	(645)[1]	?	317	153	9.00	9.00	53.	33.	6.60	4.90	84,969	29,478	175	104
Westfield	80	113	?	400	150	7.10	9.40	14.—	11.	4.20	3.60	76,941	113,133	54	78
Average — Holyoke out	$207	$176	$100	$246	$152	$13.00	$14.20	26.5	19.5	$5.27	$4.35	$72,106 (1,225,814)[2]	$97,138 (1,651,345)[2]	$109	$101
Average — Holyoke in	201	147	91	283	179	13.58	18.55	19.3	15.7	5.10	4.30	(2,069,595)[2]	(2,480,603)[2]	120	91

[1] Ceased generating current early in year.

[2] Total.

Company	Total investment													Station investment			
	Per K.W. capacity of dynamos		Per K.W. connected load	Per customer		Per capita		Per K.W.H. sold (cents)		Per dollar of operating income		Per dollar of op. inc. excluding street lighting		Total amount		Per K.W. capacity of dynamos	
	1910	1915	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915
Amesbury	$200	$190	$94	$483	$313	$13.36	$27.29	19.	22.	$3.10	$5.40	$3.90	$6.60	$62,263	$112,059	$139	$76
Attleboro	107	90	82	215	184	14.24	18.67	14.	15.	2.70	3.00	3.20	3.50	165,012	224,039	67	58
Buzzard's Bay	53	241	333	499	241	10.79	16.00	7	46.	24.00	6.50	27.10	9.40	26,624	79,974[4]	42	79
Gloucester	213	227	128	262	221	12.13	17.67	46.	46.	3.80	4.40	4.90	5.60	197,663	221,087	121	93
Great Barrington	667	457	113	309	240	17.73	20.11	26.	23.	4.00	3.80	4.60	4.30	87,773	158,480	395	306
Lee	161	259	128	220	155	9.24	9.06	50.	11.	4.00	3.00	5.20	3.70	33,600	27,288	82	101
Leominster	222	343	84	291	284	12.80	17.96	21.	14.	3.60	3.50	4.40	4.20	107,300	152,249	100	165
Northampton	174	230	86	237	169	10.69	12.67	19.	16.	2.40	2.50	2.90	3.00	113,583	140,556	96	118
Plymouth	236	539	112	313	222	13.05	21.02	30.	23.	4.40	4.70	5.20	5.40	143,356	137,050	191	190
Quincy	264	182	90	197	111	11.45	11.64	37.	21.	3.40	2.60	4.30	3.10	179,590	213,589	127	82
Weymouth	271	191	236	335	367	15.80	38.10	24.	24.	4.00	5.00	4.70	5.50	92,378	218,606	123	79
Winchendon	1,145[1]	644	234	367	533	24.20	27.24	78.	40.—	9.20	7.60	12.40	9.20	110,092	120,321	(917)[1]	481
Beverly	217	448	219	343	356	10.77	24.80	19.	31.	2.30	4.00	3.30	5.70	135,276	247,960	121	165
Citizens'	204	158	245	156	121	11.72	13.30	56.	66.	3.50	3.70	5.30	5.60	22,231	28,684	181	104
Newburyport	372	283	223	536	446	12.55	14.98	33.	26.	4.50	4.00	6.80	5.40	140,948	165,717	254	185
North Adams	155	179	78	203	178	11.71	15.51	9.—	8.5	2.40	2.40	2.90	2.70	191,075	246,466	109	123
Vineyard	144[2]	191	402	261	250	21.12	35.35	38.	42.	4.00	5.50	6.20	7.20	19,998	71,808	101[6]	101
Average	$208	$228	$126	$276	$236	$12.75	$18.48	21.4	23.0	$3.33	$3.73	$4.20		$109,374 (1,859,356)[3]	$150,998 (2,566,973)[3]	$116	$111

[1] Current bought. [2] Leased dynamo included. [3] Total. [4] Including wharf, $1,695. [5] Leased generators not included.

Municipality	Assets		Liabilities		Surplus		Deficit	
	1910	1915	1910	1915	1910	1915	1910	1915
Braintree	$120,979	$145,567	$156,260	$167,909	....	....	$35,281	$22,342
Chicopee	186,662	301,557	204,947	310,060	....	....	18,285	8,503
Concord	125,656	159,370	151,024	209,604	....	....	25,368	50,234
Danvers	136,255	195,995	137,407	188,497	....	$7,498	1,152	....
Hudson	65,015	77,992	86,458	97,680	....	....	21,443	19,688
Hull	172,975	159,374	229,539	213,988	....	....	56,564	54,614
Ipswich	56,325	90,060	52,747	79,566	$3,578	10,494	....	....
Mansfield	98,036	132,027	91,714	114,386	6,322	17,641	....	....
Marblehead	156,533	185,418	198,743	170,348	....	15,070	42,210	....
Merrimac	28,041	30,218	20,913	20,104	7,127	10,114	....	....
North Attleborough	134,906	152,360	151,207	148,577	....	3,783	16,301	....
Peabody	165,100	211,475	192,386	216,495	....	....	27,286	5,020
Reading	92,653	206,111	128,313	237,769	....	....	35,660	31,658
Taunton	456,678	586,305	457,203	545,247	19,475	41,058	....	....
Holyoke [1]	830,483 (55.7%)	1,063,487 (53.4%)	824,238	662,068	6,254	401,419(?)	....	....
Middleborough [1]	76,860 (86.1%)	86,784 (64.0%)	131,123	101,377	....	....	54,263	14,593
Wakefield [1]	81,591 (38.0%)	94,077 (41.8%)	106,500	123,894	....	....	26,909	29,817
Westfield [1]	124,493 (42.7%)	171,849 (51.0%)	82,069	96,297	42,424	75,552	....	....
Total — Holyoke out	$2,278,758	$2,986,539	$2,560,553	$3,041,798	$78,926	$189,210	$360,722	$236,469
Total — Holyoke in	3,109,241	4,050,026	3,384,791	3,703,866	85,180	582,629	....	....

[1] The assets and liabilities for all of these composite plants are computed according to the proportion which the electric plant cost bears to the combined cost of gas and electric plants, as indicated.

Company	Assets		Liabilities		Surplus		Deficit	
	1910	1915	1910	1915	1910	1915	1910	1915
Amesbury	$145,897	$210,416	$129,683	$291,481	$16,214	$18,935	....	....
Attleboro	332,896	424,511	280,505	354,316	51,890	70,195	....	....
Buzzard's Bay	22,331	264,303	34,715	267,135	....	....	$2,384	$2,742
Gloucester	372,726	515,333	241,957	300,636	130,769	215,697	....	....
Great Barrington	157,409	197,967	127,600	138,571	29,809	59,415	....	....
Lee	70,923	77,691	65,820	67,635	5,103	10,056	....	....
Leominster	256,970	335,962	247,509	335,466	8,461	496	....	....
Northampton	263,999	325,725	212,827	240,181	51,172	85,544	....	....
Plymouth	233,559	448,944	210,503	420,419	23,156	28,525	....	....
Quincy	419,540	530,092	400,226	497,896	19,314	32,196	....	....
Weymouth	230,607	576,163	206,229	546,054	23,778	30,108	....	....
Winchendon	146,094	173,862	126,700	143,167	19,324	30,695	....	....
Beverly [1]	270,286 (47.6%)	776,105 (58.0%)	193,414	626,474	76,872	149,631	....	....
Citizens' [1]	36,468 (63.0%)	44,185 (61.3%)	36,020	42,672	448	1,513	....	....
Newburyport [1]	216,452 (56.1%)	270,939 (59.5%)	189,158	211,563	27,324	59,376	....	....
North Adams [1]	312,612 (56.0%)	415,780 (60.0%)	270,312	405,634	42,300	10,146	....	....
Vineyard [1]	46,261 (61.8%)	138,572 (82.8%)	42,780	145,390	....	....	3,508	6,518
Total	$3,543,010	$5,926,960	$3,038,167	$5,135,690	$525,734	$800,526	$5,892	$9,260

[1] The assets and liabilities for all of these composite plants are computed according to the proportion which the electric plant cost bears to the combined cost of gas and electric plants, as indicated.

Municipality	Number K.W.H. generated	Coal or other fuel: Amount paid	Coal or other fuel: Per K.W.H. made (cents)	Rentals: Amount paid	Rentals: Per K.W.H. made (cents)	Oil and waste: Amount paid	Oil and waste: Per K.W.H. made (cents)	Water: Amount paid	Water: Per K.W.H. made (cents)	Wages at station: Amount paid	Wages at station: Per K.W.H. made (cents)	Plant repairs: station, steam, electric: Amount paid	Plant repairs: station, steam, electric: Per K.W.H. made (cents)	Tools, appliances, incidentals: Amount paid	Tools, appliances, incidentals: Per K.W.H made (cents)	Total cost of manufacture: Amount paid	Total cost of manufacture: Per K.W.H. made (cents)
Braintree	599,155	$6,085	1.012	....	..	$311	0.052	$702	0.117	$5,468	0.913	$ 806	0.135	$32	0.005	$13,384.73	2.251
Chicopee	999,870	9,276	.922	....	....	158	.015	196	.020	6,060	.606	1,304	.130	204	.020	17,193.95	1.720
Concord	661,940	11,820	1.313	....	....	213	.025	48	.005	7,497	.870	1,735	.201	51	.006	20,863.58	2.421
Danvers	2,533,175	21,903	.337	....	....	383	.014	683	.026	7,805	.306	3,337	.153	372	.015	34,313.19	1.355
Hudson	597,908	5,642	.944	....	....	80	.013	120	.020	6,820	1.141	264	.044	55	.009	12,962.45	2.171
Hull	414,130	5,784	1.385	....	....	121	.029	481	.117	5,822	1.406	10,325 (938)[3]	2.493 (.227)[3]	82	.010	22,565.91	5.449
Ipswich	494,653[1]	5,975	1.407	....	....	506	.119	....	....	7,237	1.704	68	.160	....	....	13,787.16	3.247
Mansfield	609,490	2,525[4]	.388	....	....	410	.063	243	.038	8,198	.492	199	.031	497	.078	7,071.27	1.160
Marblehead	904,800	11,463	1.267	....	....	424	.047	796	.088	6,336	.700	1,182	.131	433	.048	20,636.90	2.281
Merrimac	213,955	3,829	1 790	$300	0.140	182	.076	....	....	1,080	.505	127	.059	....	....	5,498.09	2.570
North Attleborough	56,710	1,510	2.663	....	....	98	.173	240	.423	2,602	4.588	388	.683	311	.548	5,153.95	9.088
Peabody	1,955,720	18,317	.937	....	....	676	.030	1,069	.055	8,970	.459	5,916	.303	299	.015	35,148.22	1 798
Reading	909,626	7,928	.872	....	....	382	.031	82	.009	8,235	.905	362	.398	257	.028	17,094.00	1.879
Taunton	4,155,600	27,610	.664	....	....	960	.020	417	.010	16,384	.394	2,855	.069	2,234	.054	50,359.00	1.212
Holyoke	13,455,100	75,326 14,358[5]	.668	....	....	569	.004	800	.006	29,209	.217	6,616	.049	444	.003	127,322.19	.946
Middleborough	438,276	3,472[4]	792	....	....	411	.094	52	.012	6,418	1.465	1,294	.319	106	.024	11,853.21	2.705
Wakefield	74,344	2,000	2 704	....	....	107	.144	48	.065	2,264	3.046	602	.810	64	.086	5,065.80	6.841
Westfield	1,659,046	14,778	.891	....	....	494	.030	50	.003	6,853	.413	2,542	.153	627	.038	25,343.56	1.528
Total—Holyoke out	17,408,398	$159,648	0.916	$300	....	$5,575	0.032	$5,181	0.030	$109,048	0.626	$32,960	0.195	$5,622	0.032	$318,533.96	1.829
Average	1,024,023	....	....	....	....	....	....	....	....	....	....	....	....	....	....	(308,037)[6]	....
Total—Holyoke in	30,863,498	246,312	.805	....	....	6,164	.020	5,981	.019	138,257	.448	40,576	.132	6,066	.020	445,656.15	1.444
Average	1,714,639	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....

[1] Estimated. [2] Uses only oil. [3] Water power rental. [4] Uses some water. [5] Boiler out. [6] Omitting Hull's new boiler, $9,397.

Company	Number K.W.H. made	Coal or other fuel		Rentals		Oil and waste		Water		Wages at station		Plant repairs: station, steam, electric		Tools, appliances, incidentals		Total cost of manufacture	
		Amount paid	Per K.W.H. made (cents)	Amount paid	Per K.W.H. made (cents)	Amount paid	Per K.W.H. made (cents)	Amount paid	Per K.W.H. made (cents)	Amount paid	Per K.W.H. made (cents)	Amount paid	Per K.W.H. made (cents)	Amount paid	Per K.W.H. made (cents)	Amount paid	Per K.W.H. made (cents)
Amesbury	1,279,392	$9,337	0.729	....	....	$247	0.019	$79	0.006	$5,472	0.428	$216	0.017	$306	0.024	$15,643.76	1.223
Attleboro	3,071,000	17,848	.581	$24	....	220	.010	174	.006	11,406	.371	1,792	.058	68	.003	31,649.70	1.031
Buzzard's Bay	594,884 (est.)	3,319 / 1,234[2]	1.606	413	0.069	471	.079	1,423	.239	6,982	1.170	873	.147	15	.002	19,711.51	3.306
Gloucester	1,591,650	11,734	.736	....	....	672	.042	1,512	.095	9,436	.593	3,247	.204	431	.027	27,032.85	1.698
Great Barrington	564,238	197[4]	....	....	....	50	....	....	....	2,961	.525	1,539	.272	474	.084	5,210 16	.923
Lee	183,234	851[4]	....	....	....	27	....	43	....	540	.294	338	.184	....	....	1,903.94	.994
Leominster	1,763,260	16,137	.915	....	....	156	.009	352	.020	7,403	.420	1,778	.101	353	.020	26,178.30	1.485
Northampton	2,065,110	17,109	.836	....	....	376	.018	192	.009	9,310	.446	3,232	.155	....	....	30,218.23	1.449
Plymouth	1,979,290	12,788	.646	....	....	629	.032	823	.042	8,508	.430	1,137	.057	....	....	23,884.34	1.202
Quincy	2,721,186	19,185	.704	....	....	382	014	1,106	.041	9,306	.342	4,230	.155	531	.019	34,719.58	1.276
Weymouth	2,694,035	29,945 / 2,960[3]	1.221	....	....	272	.010	969	.036	8,201	.304	1,931	.072	250	.009	44,528.01	1.653
Winchendon	193,780[5]	....	....	20	.010	14	....	....	....	1,019	.526	832	.429	....	....	1,885.02	973
Beverly	2,575,135	21,109	.820	....	....	153	.006	607	.024	11,887	.462	3,260	.127	....	....	37,017.00	1.437
Citizens'	78,712	2,589	3.289	....	....	399	.507	240	.305	2,465	3.132	413	.525	51	.065	6,156.79	7.847
Newburyport	1,215,942	12,002	.987	....	....	540	.044	95	.007	5,984	.492	2,341	.193	....	....	20,950.46	1.723
North Adams	5,098,850	31,531	.618	....	....	217	.004	1,323	.026	10,433	.205	3,042	.060	924	.018	47,469.83	.930
Vineyard	361,797	5,373	1.485	380	.100	362	.097	599	.166	3,297	.911	2,053	.567	22	.006	12,067.16	3.333
Total (17)	28,051,545	$220,204	0.785	$817	0.003	$5,278	0.019	$9,533	0.035	$114,500	0.409	$32,244	0.115	$3,445	0.012	$398,108.84	1.376
Total (14)[1]	27,110,943	219,157	.808	....	....	5,167	....	9,485	....	110,070	....	....	....	....	....	377,210	1.390
Average (17)	1,650,091	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....

[1] Great Barrington, Lee, Winchendon, out.
[2] Used almost solely for heating. — Water power plants.
[3] All generated by water power.
[4] Gasoline.
[5] Water power rental.

Municipality	MANUFACTURE (concluded)								DISTRIBUTION							
	Current bought			Total current made and purchased (K. W. H.)	Current sold (K. W. H.) ("sold" is used in these tables in the sense of "delivered")	Total cost of current made and purchased			Wages		Repairs and renewals of lines, lamps, meters, motors		Distribution, tools and equipment		Total cost of distribution	
	No. K. W. H.	Amount paid	Per K. W. H. bought (cents)			Amount	Per total K. W. H. (cents)	Per K. W. H. "sold" (cents)	Amount paid	Per K. W. H. "sold" (cents)	Amount paid	Per K. W. H. "sold" (cents)	Amount paid	Per K. W. H. "sold" (cents)	Amount paid	Per K. W. H. "sold" (cents)
Braintree	....	....	....	539,155	497,460	$13,384.73	2.251	3.000	$1,240	0.233	$4,739	1.052	$1,443	0.330	$7,415.61	1.493
Chicopee	1,099,220	$9,008.50	0.820	2,099,090	1,175,565	26,202.45	1.206	2.314	2,425	.206	4,404	.375	3,770	.321	10,599.49	.907
Concord	....	....	..	861,940	683,654	20,863.58	2.420	3.052	749	.109	6,155[1]	.900	783	.114	7,687.18	1.124
Danvers	....	....	....	2,533,175	2,036,168	34,313.19	1.355	1.683	444	.022	3,685	.181	917	.045	5,045.96	.247
Hudson	....	....	....	507,908	450,541	12,982.45	2.171	2.882	326	.072	3,139	.697	11	.002	3,476.18	.771
Hull	283,500	4,870.00	2.000	647,030	451,552	27,235.91	4.205	6.032	1,431	.317	8,518	1.909	3,222	.713	13,271.78	2.939
Ipswich	....	....	....	424,653	314,831	13,787 16	3.247	4.379	384	.121	672	.213	200	.063	1,255.47	.399
Mansfield	41,150	823.00	2.000	660,840	383,670	7,894.27	1 213	2.058	980	.255	3,951	.847	980	.224	5,091.59	1.327
Marblehead	....	....	....	904,800	687,152	20,635.90	2.281	3.003	2,885	.420	3,136	.456	1,522	.221	7,543.15	1.098
Merrimac	....	....	....	213,955	155,425	5,498.08	2.570	3.538	....	....	378	.243	8	.005	385.86	.248
N. Attleborough	609,140	11,269.10	1.850	685,850	545,120	16,423.05	2.466	3.013	636	.117	2,096	.568	....	..	3,734.27	.731
Peabody	....	....	....	1,955,720	1,734,506	35,148.22	1 798	2.029	1,571	.079	7,496	.432	1,901	.110	10,966.81	.635
Reading	....	....	....	909,626	682,791	17,094.00	1.879	2.504	1,422	.208	6,347	.930	1,353	.198	9,122.89	1.336
Taunton	....	....	....	4,155,600	2,994,201	50,359.00	1.219	1.682	4,979	.166	7,433	.248	3,826	.128	16,232.30	.542
Holyoke	....	....	....	13,455,100	11,394,421	127,322 19	.946	1.117	9,170	.080	18,627	.163	2,555	.022	30,352.16	.266
Middleborough	....	....	....	438,276	297,851	11,853.21	2.705	3.979	185	.062	2,858	.993	692	.232	3,704.54	1.244
Wakefield	281,451	9,720.77	2.548	455,805	369,188	14,806.57	3.248	4.011	1,057	.286	5,271	1.428	606	.165	6,936.14	1.878
Westfield	....	....	....	1,659,046	1,592,750	25,343.56	1.528	1.591	960	.060	3,421	.215	1,243	.078	5,624.55	.353
Total, Holyoke out	2,364,471	$35,491.27	1.501	19,772,869	14,992,597	$353,925.23	1.789	2.360	$21,966	0.143	$74,094	0.494	$22,328	0.149	$117,794.07	0.782
Average	131,360	....	....	1,163,110	881,914	....	....	....	....	....	....	....	....	....	....	....
Total, Holyoke in	....	....	...	33,227,969	26,386,958	481,147.52	1.448	1.823	30,536	.116	92,721	.351	24,883	.094	148,146.22	561
Average	....	....	....	1,845,998	1,465,942	....	....	....	....	....	....	....	....	....	....	....

[1] Includes $966.29 pole rental

Company	MANUFACTURE (concluded)								DISTRIBUTION							
	Current bought			Total current made and purchased (K.W.H.)	Current sold (K.W.H.)	Total cost of current made and purchased			Wages		Repairs and renewals of lines, lamps, meters, motors etc.		Distribution, tools and equipment		Total cost of distribution	
	No. K.W.H.	Amount paid	Per K.W.H. bought (cents)			Amount	Per total K.W.H. (cents)	Per K.W.H. sold (cents)	Amount paid	Per K.W.H. sold (cents)	Amount paid	Per K.W.H. sold (cents)	Amount paid	Per K.W.H. sold (cents)	Amount paid	Per K.W.H. sold (cents)
Amesbury	15,669	$568.40	3.627	1,295,061	875,240	$16,214.16	1.252	1.852	$1,863	0.213	$1,643	.188	$55	.006	$3,561.66	0.407
Attleboro	166	9.96	6.000	5,071,166	2,305,784	31,659.06	1.031	1.373	1,536	.067	4,311	.187	264	.011	6,111.35	.981
Buzzard's Bay	1,900	66.67	3.509	596,784	534,296	19,778.18	3.314	3.702	3,596	023	2,723	.510	192	.036	6,510.27	1.218
Gloucester	....	....	....	1,591,650	1,182,629	27,022.85	1.698	2.285	6,306	.542	10,540	.891	3,969	.336	20,813.06	1.768
Great Barrington	272,051	4,780.51	1.757	836,239	553,072	9,990.67	1.195	1.806	1,078	.195	3,823	.691	177	.032	5,078.85	.918
Lee	527,350	8,173.93	1.550	710,634	614,050	9,977.87	1.404	1.625	325	.052	925	.039	239	.151	1,489.40	.943
Leominster	816,359	12,267.38	1.501	2,551,619	2,200,694	38,459.08	1.480	1.701	1,185	.052	4,578	.202	1,023	.047	6,816.40	.315
Northampton	....	....	....	2,085,110	1,676,741	30,218.33	1.449	1.802	1,751	.105	5,031	.300	479	.029	7,260.56	.433
Plymouth	....	....	....	1,979,290	1,825,273	23,884.34	1.202	1.309	1,364	.075	8,882	.487	802	.033	10,847.65	.594
Quincy	....	....	....	2,721,186	2,254,606	34,719.68	1.276	1.540	12,068	.536	23,579	1.046	9,319	.435	45,485.85	2.017
Weymouth	....	....	....	2,694,085	2,189,952	44,528.01	1.653	2.033	2,029	.093	6,526	.298	98	.004	8,653.23	.396
Winchendon	313,133	4,387.98	1.391	506,966	423,567	6,242.95	1.251	1.474	1,968	.469	179	.042	365	.086	2,532.52	.598
Beverly	....	....	....	2,575,135	2,185,887	37,017.00	1.437	1.693	2,455	.112	6,806	.311	4,305	.197	13,565.63	.621
Citizens'	....	....	....	78,712	63,952	6,156.79	7.847	9.627	97	.152	1,085	1.696	....	....	1,182.24	1.849
Newburyport	....	....	....	1,215,942	1,014,577	20,950.46	1 723	2.065	1,941	.191	3,769	.371	76	.007	5,786.07	.570
North Adams	....	....	....	5,098,350	4,155,698	47,469.83	.930	1.142	2,022	.049	5,583	.134	880	.021	8,485.48	.204
Vineyard	....	....	....	361,797	322,118	12,057.16	3.333	3.743	2,612	.811	1,650	.512	23	.007	4,284.08	1.330
Total	1,948,683	$30,226.73	1.550	80,000,226	24,488,941	$416,347.62	1.388	1.704	$44,936	0.181	$91,633	.375	$22,556	0.093	$159,464.50	0.648
Average	106,748	....	....	1,764,719	1,437,544	....	....	....	....	....	....	....	....	....	....	....

Municipality	General salaries		Salaries of board		General office expenses		Insurance	
	Amount paid	Per K.W.H. "sold" (cents)	Amount paid	Per K.W.H. "sold" (cents)	Amount paid	Per K.W.H. "sold" (cents)	Amount paid	Per K.W.H. "sold" (cents)
Braintree	$1,993	0.456	$300	0.069	$451	0.103	$830	0.190
Chicopee	3,003	.255	....	....	980	.083	765	.065
Concord	3,103	.454	105	.015	817	.119	27	.004
Danvers	1,404	.069	150	.007	1,481	.073	1,518	.074
Hudson	1,900	.422	....	....	914	.203	161	.036
Hull	3,500	.775	....		4,097	.907	2,281	.505
Ipswich	705	.224	300	.095	266	.084	985	.313
Mansfield	2,578	.672	500	.130	448	.117	1,043	.272
Marblehead	3,264	.475	....	....	1,185	.172	1,529	.223
Merrimac	650	.419	37	.024	95	.061	266	.171
North Attleborough	2,025	.372	600	.110	449	.082	813	.149
Peabody	2,435	.140	300	.017	2,439	.141	2,725	.157
Reading	3,518	.515	225	.033	1,414	.207	1,364	.200
Taunton	4,331	.145	....	....	2,588	086	2,019	.067
Holyoke	13,811	.121	....	....	6,862	.060	2,068	.018
Middleborough	1,859	.624	250	.084	430	.145	378	.127
Wakefield	1,948	.528	150	.004	405	.110	607	.164
Westfield	2,532	.159	250	.016	1,825	.115	2,179	.137
Total — Holyoke out	$40,750	0.272	$3,167	0.022	$20,285	0.135	$19,507	0.130
Total — Holyoke in	54,561	.207	....	.012	27,147	.103	21,605	.082

Company	General salaries		Salaries of officers		Directors' allowances		General office expenses		Insurance	
	Amount paid	Per K.W.H. sold (cents)	Amount paid	Per K.W.H. sold (cents)	Amount paid	Per K.W.H. sold (cents)	Amount paid	Per K.W.H. sold (cents)	Amount paid	Per K.W.H. sold (cents)
Amesbury	$2,892	0.230	....	....	$245	0.028	$1,090	0.126	$2,073	0.237
Attleboro	2,496	.108	$10,000	0.434	....	....	2,986	.127	1,896	.083
Buzzard's Bay	....	....	600	.112	28	.005	702	.131	650	.123
Gloucester	1,200	.101	2,350	.241	1,480	.122	3,126	.265	3,808	.323
Great Barrington	2,156	.200	4,800	.368	320	.056	776	.140	1,189	.215
Lee	....	....	1,292	.227	59	.010	191	.081	476	.077
Leominster	3,296	.147	900	.040	450	.020	8,097	.358	1,989	.087
Northampton	3,911	.233	1,700	.101	270	.016	9,567	.571	1,552	.093
Plymouth	1,581	.097	6,240	.382	180	.010	6,016	.368	2,470	.152
Quincy	5,238	.232	9,600	.426	420	.019	3,497	.155	3,769	.167
Weymouth	3,690	.168	....	....	....	....	2,014	.092	1,811	.083
Winchendon	....	....	2,418	.371	....	....	1,143	.370	494	.117
Beverly	2,490	.114	4,336	.197	1,260	.057	1,555	.071	3,940	.180
Citizens'	....	....	674	1.054	....	....	552	.869	582	.910
Newburyport	2,495	.246	1,060	.106	450	.045	1,245	.123	1,141	.113
North Adams	4,336	.104	1,133	.027	240	.006	13,104	.315	2,504	.060
Vineyard	....	....	490	.149	15	.005	543	.169	366	.114
Total	$35,781	0.146	$48,200	0.197	$5,238	0.022	$56,158	0.230	$30,708	0.126

OPERATING EXPENSES (*concluded*)

Municipality	MANAGEMENT AND MISCELLANEOUS (*concluded*)								TOTAL	
	Law expenses		*Bad debts*		*Rent of offices*		*Other expenses*			
	Amount paid	*Per K.W.H. "sold" (cents)*	*Amount lost*	*Per K.W.P. "sold" (cents)*	*Amount paid*	*Per K.W.H. "sold" (cents)*	*Amount paid*	*Per K.W.H. "sold" (cents)*	*Amount paid*	*Per K.W.H. "sold" (cents)*
Braintree	....	....	....	....	....	....	....	....	$24,375.33	5.595
Chicopee	....	....	$37	0.003	....	....	$427	0.036	42,017.64	3.574
Concord	....	....	24	.003	....	....	....	....	32,626.60	4.772
Danvers	....	....	....	....	$240	0.012	....	....	44,153.35	2.166
Hudson	....	....	....	....	....	....	66	.015	19,499.26	4.328
Hull	....	....	....	....	....	....	239	.053	50,624.70	11.211
Ipswich	....	.. .	....	....	....	....	....	....	17,298.43	5.495
Mansfield	....	....	5	....	....	....	57	.015	17,612.80	4.591
Marblehead	$100	0.015	....	.001	84	.012	....	....	34,346.75	4.998
Merrimac	....	....	....	....	....	....	....	....	6,932.93	4.461
North Attleborough	....	....	99	.018	....	....	....	....	24,143.84	4.429
Peabody	....	....	776	.045	....	....	....	....	54,489.64	3.141
Reading	....	....	....	....	435	.064	364	.053	33,536.78	4.912
Taunton	35	.001	611	.020	120	.004	1,311	.044	77,606.95	2.592
Holyoke	....	....	....	....	....	....	940	.008	181,384.75	1.592
Middleborough	....	....	397	.133	....	....	....	....	18,872.63	6.336
Wakefield	....	....	18	.005	....	....	135	.037	25,005.70	6.774
Westfield	....	....	....	....	241	.015	1,505	.095	39,499.86	2.480
Total — Holyoke out.	$135	0.001	$1,967	0.013	$1,120	0.007	$4,103	0.027	$562,643.19	3.766
Total — Holyoke in ..	....	....	....	.007	....	....	5,043	.019	744,027.94	2.820

Company	MANAGEMENT AND MISCELLANEOUS (*concluded*)										TOTAL	
	Taxes		*Law expenses*		*Bad debts*		*Rent of offices*		*Other expenses*			
	Amount paid	*Per K.W.H. sold (cents)*	*Amount paid*	*Per K.W.H. sold (cents)*	*Amount lost*	*Per K.W.H. sold (cents)*	*Amount paid*	*Per K.W.H. sold (cents)*	*Amount paid*	*Per K.W.H. sold (cents)*	*Amount paid*	*Per K.W.H. sold (cents)*
Amesbury	$4,393	0.502	$42	0.005	....	....	$208	0.024	....	....	$30,719.41	3.509
Attleboro	11,441	.496	135	.006	$3	....	668	.029	....	....	67,345.75	2.921
Buzzard's Bay	784	.147	403	.075	....	....	451	.085	....	....	29,916.66	5.599
Gloucester	9,576	.810	634	.054	....	....	1,663	.141	$341	0.030	72,505.65	6.131
Great Barrington	4,293	.776	....	....	65	0.012	500	.090	....	....	29,171.27	5.274
Lee	714	.116	....	....	....	....	78	.013	....	....	14,377.86	2.341
Leominster	8,945	.264	1,058	.047	270	.012	452	.020	75	.003	67,788.28	3.000
Northampton	5,969	.356	930	.055	4	....	873	.052	....	....	62,256.46	3.713
Plymouth	4,054	.322	....	....	....	....	512	.028	....	....	55,786.08	3.563
Quincy	13,136	.583	539	0.24	1,844	.082	786	.035	318	.014	119,336.07	5.293
Weymouth	9,517	.435	....	....	....	....	....	....	....	....	70,212.81	3.206
Winchendon	879	.206	....	....	....	....	180	.042	36	.008	13,925.84	3.268
Beverly	18,560	.849	150	.007	231	.011	500	.023	725	.033	84,320.46	3.858
Citizens'	770	1.205	25	.039	....	....	100	.156	....	....	10,042.41	15.705
Newburyport	6,342	.625	81	.008	....	....	....	....	....	....	40,050.20	3.947
North Adams	7,121	.171	387	.009	32	.001	966	.023	2	....	85,780.59	2.064
Vineyard	1,094	.340	166	.051	42	.013	290	.090	61	.019	19,399.29	6.022
Total	$104,591	0.426	$4,550	0.019	$2,492	0.010	$8,228	0.034	$1,558	0.006	$872,935.09	3.572

Municipality	K.W.H. generated	Tons of coal used (2,240 lbs.)[1]	Costs			Pounds of coal used		Number watt hours made per pound coal
			Per ton	Total	Per K.H.W. generated (cents)	Total	Per K.W.H. generated	
Braintree	888,185	1,097.00 223.00	$2.57 4.32	$3,084.89	1.012	3,776,980	0.577	189
Chicopee	999,970	2,951.38	4.15	9,178.04	0.918	5,044,922	5.045	198
Concord	951,940	1,809.89 1,581.71	3.32 4.35	11,519.99	1.213	6,992,944	7.352	136
Danvers	2,536,175	20.00 4,498.8	2.65 4.75	21,838.81	0.860	10,042,719	3.965	252
Hudson	597,808	1,190.00	4.74	5,642.46	0.944	2,695,800	4.458	221
Hull	414,180	1165.5 216.45	3.80 5.80	5,754.20	1.396	2,518,287	6.080	165
Ipswich	624,658	1,212.00	4.94	5,974.99	2.407	2,714,980	0.208	187
Mansfield (uses oil only)	809,460	(60,749 gals. oil)	(0.0822 per gal.)	(3,994.95)	(1.228)	oil	(0.114)	(3,772)[4]
Marblehead	904,800	2,852.5	4.69	11,992.85	1.297	5,781,040	6.304	156
Merrimac	813,065	1314.00 1668.00	3.20 5.70	8,201.06	1.760	3,654,080	9.801	104
North Attleborough	98,750	295.00	4.66	1,509.85	2.606	758,640	15.373	75
Peabody	1,965,720	5,675.76	5.01	15,218.54	0.967	8,262,708	4.210	237
Reading	909,026	238.85 1,615.27	2.52 4.41	7,967.80	0.871	4,276,809	4.709	200
Taunton	2,155,800	6,159.00 12.5	4.46 7.14	27,510.17	0.994	12,313,780	5.546	209
Holyoke (part water)	18,455,100	27,080.00	4.61	75,288.80 (14,997.60)[2]	0.980 (0.102)	88,889,200	(3.548)[3]	(201)[3]
Middleborough (gas and water	482,276	165.41 1858.20	5.11 6.65	8,478.78	0.782	1,289,626	(1.806)[3]	(262)[3]
Wakefield	74,994	401.27 59.85	4.09 4.29	2,000.11	2.704	1,068,240	14.782	69
Westfield	1,898,046	3,286.76	2.50+	24,777.78	0.891	7,519,161	4.589	251
Total (15) (Holyoke, Middleborough, and Mansfield out)	16,260,628	24,241.07	$4.66	$120,480.26	0.988	76,794,629	4.680	218
Total for all (17)	20,254,028	31,280.26	4.68	151,449.24	0.795	114,218,260	5.541	200

[1] Screenings, etc., included. [2] Water power rental. [3] Partly generated by water power. [4] Per gallon of oil.

Company	K.W.H. generated	Tons of coal used (2,240 lbs.)[1]	Costs			Pounds of coal used		Number watt hours made per pound coal
			Per ton	Total	Per K.W.H. generated (cents)	Total	Per K.W.H. generated	
Amesbury	1,579,293	421.6 1,574.5	$2.77 4.73	$9,328.81	0.739	3,989,519	2.525–	396
Attleboro	6,071,606	2,073. 1,295.	4.04 4.89	17,945.73	.561	9,772,960	3.168	316
Bussard's Bay	954,524	(3,788.)[2] 1,677.5	0.14 4.89	(1,324.42)[3] 8,519.11	(.307)[3] 1.401–	2,787,224	(.415)[3] 4.317	138
Gloucester	1,891,980	475. 2,792.	2.03 2.85	11,728.56	.787	7,292,040	4.809	259
Great Barrington	854,295	(5)						
Lee	153,264	(5)						
Leominster	1,793,960	4,200.	5.04	18,148.80	.815	9,408,000	5.246	191
Northampton	2,005,110	2,582.	4.45	17,158.79	.856	8,268,680	4.021	249
Plymouth	1,979,280	2,574. 425.	4.95 4.85	12,787.88	.646	6,872,980	3.471	287
Quincy	2,792,180	7,397 2,472.5	3.07 4.35	19,165.05	.704	10,937,980	4.008	250
Weymouth	2,654,085	2,295. 6,000.	3.97 4.94	22,284.85 (3,960.38)[4]	1.111 (.210)	14,167,840	5.388	191
Winchendon	168,760	(5)						
Beverly	2,978,195	180. 4,841.	1.98 4.91	21,159.61	.830	11,125,040	4.284	268
Citizens'	78,715	270. 252.	4.63 5.43	2,588.94	3.289	1,128,240	14.328	70
Newburyport	1,915,942	82. 2,512.54	1.95 4.75	12,001.87	.627	5,744,574	4.726	333
North Adams	6,086,860	1,982. 94.	4.15 5.80	31,580.96	.515	17,086,720	5.260	356
Vineyard	861,797	1,127.3	4.76	5,373.04	1.235	2,524,926	5.978	149
Total (14)	[redacted]	30,362.34	$4.65	$214,992.89	0.739	112,194,263	4.175	240
Total (19) (Bussard's Bay and Weymouth out)		26,205.14	4.15	170,693.82	.761	93,273,715	4.000	280

[1] Screenings, etc., included. [2] Gallons gasoline. [3] Water power. [4] Water power rental.

Municipality	Lighting — Commercial and domestic			Municipal buildings			Power			Sales to other companies		
	No. K.W.H. sold	Amount received	Per K.W.H. (cents)	No. K.W.H. sold	Amount received	Per K.W.H. (cents)	No. K.W.H. sold	Amount received	Per K.W.H. (cents)	No. K.W.H. sold	Amount received	Per K.W.H. (cents)
Braintree	245,338	$24,131.83	9.836	3,892	$389.20	10.000	45,000	$1,980.80	4.402	....	....	....
Chicopee	323,566	29,303.43	9.056	57,590	4,170.57	7.242	402,322	12,355.52	3.071	....	....	....
Concord	333,663	30,686.52	9.257	23,939	1,110.80	4.634	135,312	4,367.03	3.227	....	....	....
Danvers	287,340	29,596.37	10.300	3,612	371.40	10.282	1,393,365	22,770.20	1.634	18,843	$1,130.58	6.000
Hudson	156,706	17,130.60	10.932	5,206	573.56	11.017	196,451	5,524.23	2.812	....	....	....
Hull	292,432	43,347.19	14.823	6,640	996.00	15.000	74,429	3,357.68	4.511	406	16.20	4.000
Ipswich	126,772	13,945.98	11.001	4,409	485.93	11.021	....	....	....	41,130	2,467.80	6.000
Mansfield	144,087	16,378.29	11.367	6,785	742.37	10.941	144,914	5,637.23	3.925	980	43.31	4.931
Marblehead	268,293	30,569.17	11.394	19,294	1,965.28	10.186	120,505	5,388.35	4.472	....	....	....
Merrimac	27,908	3,625.75	13.037	1,200	180.00	15.000	88,962	4,181.61	4.699	....	....	....
North Attleborough	181,466	22,593.52	12.451	5,927	711.29	12.001	247,237	7,016.85	2.838	....	....	....
Peabody	314,884 [1]	33,552.13	10.655	19,142	1,533.80	9.581	1,100,544	28,719.38	2.609	26,500	691.75	2.350
Reading	299,773 / 47,324 [2]	26,600.70 / 7,349.01	11.796	7,684	502.59	6.541	131,787	5,640.49	4.280	39,230	1,194.31	3.044
Taunton	653,340	57,873.10	8.852	52,917	4,151.49	7.902	1,614,406	37,140.22	2.301	....	....	....
Holyoke	2,726,285	163,063.67	5.981	171,510	3,430.20	2.000	7,199,289	121,268.61	1.685	236,857	4,777.14	2.000
Middleborough	162,723	21,981.00	13.508	9,250	990.12	10.704	83,250	4,511.55	5.419	....	....	....
Wakefield	170,486	19,127 29	11.219	6,969	761.29	11.520	37,013	2,463.75	6.657	....	....	....
Westfield	390,791	27,365.03	7.003	33,312	1,472.58	4.421	757,111	18,671.38	2.466	....	....	....
Total — Holyoke out	4,427,265	$462,361.86	10.443	267,496	$21,448.27	8.018	5,572,826	$169,776.25	2.562	126,883	$5,448.95	4.294
Total — Holyoke in	7,153,570	626,425.53	8.742	439,009	24,878.47	5.667	13,772,097	291,044.86	2.113	365,745	10,226.09	2.800

[1] Includes 9,902 K.W.H. sold for street lighting elsewhere.

[2] Sold for street lighting elsewhere.

Company	Lighting — Commercial and domestic [1]			Public street lighting			Power			Sales to other companies		
	No. K.W.H. sold	Amount received	Per K.W.H. (cents)	No. K.W.H. sold	Amount received	Per K.W.H. (cents)	No. K.W.H. sold	Amount received	Per K.W.H. (cents)	No. K.W.H. sold	Amount received	Per K.W.H. (cents)
Amesbury	169,125	$23,618.91	13.374	98,344	$9,740.99	9.905	607,333	$19,318.95	3.178	....	....	....
Attleboro	540,772	54,755.14	10.125	297,329	17,547.06	5.443	1,554,549	43,110.47	2.773	2,634	$156.08	6.000
Buzzard's Bay	424,310	24,313.66	5.598	67,177	11,604.92	17.275	32,809	1,545.96	4.712	....	....	....
Gloucester	570,923	77,518.43	13.630	293,700	26,389.33	8.985	317,994	17,906.29	5.631	....	....	....
Great Barrington	207,349	30,207.63	14.568	57,266	5,370.39	9.379	283,457	12,550.21	4.351	....	....	....
Lee	275,975	13,001.10	4.711	22,455	4,396.00	19.686	315,520	5,793.90	1.836	....	....	....
Leominster	266,680	32,568.20	11.361	177,479	15,569.23	8.779	1,449,597	36,331.82	2.506	346,937	6,972.01	2.019
Northampton	659,013	60,976.33	9.253	230,783	15,702.25	6.805	676,155	27,916.26	4.129	110,810	1,662.15	1.500
Plymouth	688,637	49,393.66	7.180	125,840	11,666.33	9.271	834,841	21,968.66	2.634	176,555	2,808.30	1.591
Quincy	870,469	116,977.73	13.438	500,429	32,902.30	6.575	883,710	34,651.82	3.921	....	....	....
Weymouth	500,593	44,853.85	8.961	82,446	10,861.65	13.320	494,806	16,307.02	3.296	1,112,197	34,412.16	3.000
Winchendon	132,493	11,867.96	8.973	61,055	4,731.73	7.750	227,799	4,472.73	1.963	2,220	33.30	1.500
Beverly	772,724	87,055.35	11.266	396,566	51,692.08	5.765	249,707	13,645.45	5.467	267,900	11,990.93	4.476
Citizens'	39,972	7,473.75	18.697	23,380	4,006.90	16.709	....	....	....	....	....	....
Newburyport	218,203	39,155.66	13.393	321,330	16,595.18	5.165	475,054	16,291.16	3.415	....	....	....
North Adams	347,670	71,730.72	8.462	293,648	19,918.95	6.783	2,001,279	45,102.33	2.254	1,013,091	15,202.82	1.507
Vineyard	266,075	17,649.89	6.709	33,100	5,825.50	17.600	22,943	1,016.94	4.432	....	....	....
Total	7,480,226	$782,657.70	10.462	3,406,365	$264,541.27	7.575	10,432,213	$317,880.64	3.047	3,032,344	$73,306.75	2.418

[1] Sales to public buildings included — cannot be separated.

OPERATING INCOME (*concluded*)

Municipality	Other operating income[1]		Total operating income			Number K.W.H. supplied for street lighting at home
	Amount received	Per K.W.H. "sold" (cents)	Number K.W.H. sold	Amount received	Per K.W.H. "sold" (cents)	
Braintree	....	....	294,030	$26,481.83	9.007	143,430
Chicopee	$3,237.45	0.400	783,476	49,067.02	6.263	392,089
Concord	2,400.24	.500	492,944	38,764.59	7.864	190,710
Danvers	....	....	1,703,060	53,868.55	3.163	333,108
Hudson	1,200.00	.333	358,363	24,428.39	6.817	92,178
Hull	751.07	.200	373,906	48,468.12	12.963	77,646
Ipswich	2,224.40	1.293	172,311	19,124.01	11.099	142,520
Mansfield	....	....	296,766	22,856.20	7.702	86,904
			(383,670)[2]	(30,109.20)[2]		
Marblehead	....	....	406,088	37,922.80	9.338	279,064
Merrimac	....	....	117,990	7,987.36	6.770	37,435
North Attleborough	....	....	434,610	30,574.94	7.035	110,510
Peabody	741.66	.050	1,461,470	65,438.72	4.478	273,038
Reading	727.33	.140	525,794	49,014.43	9.322	156,997
Taunton	....	....	2,321,133	99,199.81	4.274	673,168
Holyoke	....	....	10,335,921	292,559.62	2.831	1,058,500
			(11,394,421)[2]	(320,302.98)[2]		
Middleborough	....	....	255,223	27,482.67	10.768	42,658
Wakefield	1,200.00	.561	214,371	23,582.33	11.001	154,797
Westfield	....	....	1,181,214	47,508.99	4.022	411,536
Total — Holyoke out	$12,482.15	0.110	11,394,479	$671,760.76	5.895	3,597,788
Average	....	....	670,263	....	....	211,635
Total — Holyoke in	....	....	21,730,400	964,320.38	4.438	4,656,288
Average	....	....	1,207,244	....	....	258,683

[1] Includes sale of steam, rent of fixtures, etc.

[2] Including street lighting. These municipalities pay their plants, but this is not put in totals.

OPERATING INCOME (*concluded*)

Company	Other operating income[1]		Total operating income			Operating income (Exclusive of street lighting)		
	Amount received	Per K.W.H. sold (cents)	Number K.W.H. sold	Amount received	Per K.W.H. sold (cents)	Number K.W.H. sold	Amount received	Per K.W.H. sold (cents)
Amesbury	$379.19	0.043	875,350	$52,038.02	5.947	777,016	$42,317.03	5.472
Attleboro	....	....	2,305,784	115,570.71	5.012	2,097,855	96,023.65	4.578
Buzzard's Bay	....	....	534,296	37,464.54	7.012	467,119	25,859.62	5.536
Gloucester	....	....	1,182,622	122,114.75	10.326	888,922	95,725.42	10.769
Great Barrington	....	....	553,072	43,128.73	8.702	495,805	42,757.84	8.624
Lee	....	....	614,050	23,191.00	3.777	591,595	18,795.00	3.177
Leominster	$4.41	.000	2,260,634	91,505.67	4.048	2,083,214	75,936.44	3.645
Northampton	1,683.54	.100	1,676,741	107,840.53	6.432	1,445,978	92,138.28	6.372
Plymouth	....	....	1,925,273	85,856.95	4.704	1,699,433	74,190.62	4.366
Quincy	....	....	2,254,608	184,531.85	8.187	1,753,179	151,629.55	8.647
Weymouth	802.29	.093	2,180,962	107,157.06	4.913	2,107,508	96,175.43	4.563
Winchendon	....	....	423,567	21,125.72	4.989	382,512	16,393.09	4.322
Beverly	4,339.95	.207	2,185,857	169,913.76	7.727	1,289,321	117,221.66	9.092
Citizens'	....	....	63,962	11,490.65	17.962	39,972	7,473.75	18.700
Newburyport	1,610.94	.159	1,014,577	63,581.86	6.267	698,257	46,966.68	6.778
North Adams	....	....	4,155,698	152,020.81	3.658	3,962,050	132,101.86	3.420
Vineyard	....	....	322,118	24,692.13	7.666	289,018	18,866.63	6.528
Total	$8,870.42	0.036	24,438,941	$1,417,234.74	5.800	20,944,853	$1,152,593.52	5.503
Average	....	....	1,437,544	83,366.75	....	1,232,050	67,799.62	....

[1] Includes sale of steam, rent of fixtures, etc.

Municipality	Operating expenses				Operating income			
	Amount		Per K.W.H. supplied (cents)		Amount		Per K.W.H. sold (cents)	
	1910	1915	1910	1915	1910	1915	1910	1915
Braintree	$18,499.24	$24,375.33	5.236	5.595	$22,714.79	$26,481.83	11.856	9.006
Chicopee	31,994.89	42,017.64	3.660 [1]	3.574	34,173.90	49,067.02	5.300 [1]	6.263
Concord	21,818.33	$2,626.60	5.051	4.772	27,328.50	38,764.59	9.767	7.864
Danvers	22,228.45	44,153.35	3.761	2.166	28,542.57	53,868.55	6.380	3.163
Hudson	16,034.79	19,499.26	4.284	4.328	21,527.13	24,428.39	6.914	6.817
Hull	25,748.74	50,624.70	12.720	11.211	27,568.32	48,468.12	16.719	12.963
Ipswich	10,383.07	17,298.43	4.762	5.494	9,784.81	19,124.01	13.974	11.098
Mansfield	16,315.60	17,612.80	5.329	4.591	16,481.18	22,856.20	8.162	7.702
Marblehead	28,839.76	34,346.75	5.774	4.998	30,115.03	37,922.80	9.780	9.293
Merrimac	5,908.87	6,932.93	3.012	4.461	9,236.68	7,987.36	5.729	6.769
North Attleborough	21,251.08	24,143.84	7.661	4.429	27,025.02	30,574.94	14.922	7.035
Peabody	36,370.70	54,489.64	6.710	3.141	32,046.97	65,438.72	12.990	4.478
Reading	21,549.98	33,536.78	4.222	4.912	24,227.63	49,014.43	8.558	9.322
Taunton	49,576.43	77,606.95	2.632	2.592	72,544.78	99,199.81	5.893	4.274
Holyoke	130,806.13	181,384.75	1.650	1.592	189,094.81	292,559.62	2.685	2.830
Middleborough	12,374.76	18,872.63	6.524	6.336	17,500.29	27,482.67	11.740	10.420
Wakefield	17,914.66	24,870.57	9.669	6.773	15,452.82	23,582.33	15.206	11.001
Westfield	24,461.88	39,499.86	2.923	2.480	27,152.80	47,506.99	5.182	4.022
Total — Holyoke out	$381,221.23	$562,643.19	4.340	3.766	$443,423.22	$671,760.76	7.960	5.895
Total — Holyoke in	512,027.36	744,027.94	3.063	2.820	632,518.03	964,320.38	5.048	4.438

[1] For 1911.

Company	Operating expenses				Operating income				Operating income, exclusive of street lighting income			
	Amount		Per K.W.H. sold (cents)		Amount		Per K.W.H. sold (cents)		Amount		Per K.W.H. sold (cents)	
	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915
Amesbury	$26,200.53	$30,719.41	3.778	3.509	$42,957.91	$52,058.02	6.194	5.947	$33,962.39	$42,317.03	5.504	5.472
Attleboro	53,343.08	67,345.75	2.801	2.921	97,224.12	115,570.71	5.105	5.012	82,591.09	98,023.65	4.777	4.673
Buzzard's Bay	3,611.07 (4,806.64)[1]	29,916.66	?	5.599	1,406.12 (6,346.03)[1]	37,464.54	?	7.012	1,250.12 (3,905.08)[1]	25,859.62	?	5.536
Gloucester	64,089.75	72,505.65	8.540	6.131	92,199.85	122,114.75	12.284	10.326	70,594.84	95,725.42	13.384	10.769
Great Barrington	26,130.64	29,171.27	4.554	5.274	37,040.84	48,128.73	6.456	8.702	32,471.24	42,757.84	6.518	8.624
Lee	10,317.08	14,377.86	7.781	2.341	16,350.73	23,191.00	12.332	3.777	12,836.73	18,795.00	11.164	3.177
Leominster	43,897.22	67,788.28	3.886	2.999	66,563.64	91,505.67	5.893	4.048	53,930.17	75,936.44	5.805	3.645
Northampton	50,555.68	62,256.46	4.545	3.713	88,207.50	107,840.53	7.930	6.432	72,263.26	92,138.28	8.582	6.372
Plymouth	35,828.93	55,786.08	4.905	3.563	50,808.85	85,856.95	6.956	4.704	42,652.89	74,190.62	6.434	4.366
Quincy	73,354.64	119,336.07	7.251	5.293	111,259.04	184,531.85	10.997	8.185	87,064.16	151,629.55	12.960	8.637
Weymouth	40,558.08	70,212.81	4.801	3.206	51,017.84	107,157.06	6.039	4.893	42,873.98	96,175.43	5.562	4.563
Winchendon	10,737.00	13,925.84	6.128	3.288	14,855.14	21,125.72	8.479	4.966	11,110.42	16,393.99	8.750	4.522
Beverly	56,840.71	84,320.46	4.300	3.858	104,069.48	168,913.76	7.869	7.727	73,961.28	117,221.68	9.360	9.092
Citizens'	8,468.53	10,042.41	13.757	15.703	10,012.90	11,480.65	16.266	17.952	6,572.58	7,473.75	19.019	18.700
Newburyport	28,656.99	40,050.20	4.536	3.947	45,962.64	63,581.86	7.274	6.267	32,562.78	46,986.68	6.466	6.778
North Adams	98,872.35	85,780.59	2.925[1]	2.064	111,661.56	152,020.81	3.835[1]	3.682	92,886.64	132,101.86	3.670[1]	3.429
Vineyard	9,527.23	19,399.29	8.112[1]	6.022	12,086.81	24,692.13	12.750[1]	7.666	7,709.06	18,866.63	10.740[1]	6.528
Total	$640,989.51	$872,935.09	4.386[2]	3.572	$953,674.97	$1,417,234.74	6.808[2]	5.800	$757,293.83	$1,152,593.52	6.531	5.503

[1] For 1911.

[2] Buzzard's Bay omitted — just beginning in 1910. Returns still incomplete in 1911. North Adams and Vineyard corrected for 1911, as returns are incomplete for 1910.

COMPARATIVE INCOME (1910–1915)

Municipality	*Commercial light*		*Power*		*Sales to other companies*		*Other sources*	
	1910	1915	1910	1915	1910	1915	1910	1915
Braintree	$21,634	$24,501	$377	$1,981	....	....	$704	....
Chicopee	26,693	33,474	4,548	12,356	....	....	3,133	$3,237
Concord	23,544	31,997	1,777	4,367	....	....	2,008	2,400
Danvers	20,646	29,968	7,897	22,770	....	$1,131	....	....
Hudson	14,870	17,704	5,457	5,524	....	....	1,200	1,200
Hull	26,228	44,343	257	3,358	$693	16	525	751
Ipswich	8,168	14,432	....	....	....	2,468	1,617	2,224
Mansfield	12,623	17,121	3,666	5,687	192	48	....	....
Marblehead	27,653	32,534	2,462	5,388	....	....	....	....
Merrimac	2,947	3,806	6,289	4,182	....	....	....	....
North Attleborough	25,524	23,305	1,125	7,017	....	....	376	....
Peabody	26,430	35,386	5,017	28,719	....	592	600	742
Reading	19,037	41,452	3,096	5,640	1,777	1,194	318	727
Taunton	42,201	62,060	30,244	37,140	....	....	....	....
Holyoke	95,872	166,494	93,223	121,289	....	4,777	....	....
Middleborough	15,202	22,971	2,229	4,512	....	....	....	....
Wakefield	14,353	19,919	....	2,464	....	....	1,100	1,200
Westfield	18,572	28,838	7,697	18,671	....	....	686	....
Total — Holyoke out	$346,325	$483,810	$82,248	$169,776	$2,562	$5,449	$12,265	$12,481
Total — Holyoke in	442,197	650,304	175,471	291,065	....	10,226	....	....

Company	Commercial light		Power		Street lighting		Sales to other companies		Other sources	
	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915
Amesbury	$14,379	$22,619	$18,266	$19,319	$6,996	$9,741	....	$158	$1,317	$379
Attleboro	43,373	54,755	39,162	43,110	14,632	17,547	....	....	158	....
Buzzard's Bay	1,239	24,314	11	1,546	156	11,605	....	....	....	....
	(3,556)[1]		(40)[1]		(2,441)					
Gloucester	66,623	77,318	11,972	17,907	21,606	26,389	....	....	....	....
Great Barrington	24,450	30,208	5,748	12,550	4,570	5,371	$2,273	....	....	....
Lee	12,337	12,001	....	5,794	3,514	4,396	....	....	....	....
Leominster	30,735	32,558	23,195	36,332	12,633	15,569	....	6,972	....	84
Northampton	58,509	60,976	10,047	27,916	15,944	15,702	1,874	1,662	1,934	1,984
Plymouth	27,535	40,394	15,118	21,989	8,156	11,566	....	2,808	....	....
Quincy	65,018	116,978	22,046	34,692	24,195	32,902	....	....	....	....
Weymouth	20,483	44,854	5,414	16,207	3,144	10,962	13,267	34,412	600	602
Winchendon	10,016	11,883	1,094	4,473	3,745	4,732	....	33	....	....
Beverly	55,997	87,055	6,967	13,645	30,108	51,692	6,712	11,991	2,285	4,530
Citizens'	6,573	7,474	....	....	3,440	4,007	....	....	....	....
Newburyport	21,943	29,156	9,448	16,221	13,390	16,395	....	....	1,188	1,611
North Adams	60,563	71,731	19,743	45,102	16,775	19,819	12,576	15,289	....	....
Vineyard	5,398	17,350	2,111	1,017	4,378	5,836	....	....	....	....
Total	$517,775	$752,630	$193,943	$317,880	$196,562 (173,073)[2]	$264,641 (237,291)[2]	$36,722	$73,306	$7,452	$9,870

[1] For 1911.

[2] Buzzard's Bay, North Adams, and Vineyard out.

Municipality	Average price per K.W.H. received for current sold (cents)						Operating income (dollars)					
							Per customer				Per K.W. capacity	
	Total		Commercial light		Power		Light		Power			
	1910	1915	1910	1915	1910	1915	1910	1915	1911	1915	1910	1915
Braintree	11.485	9.006	11.728	9.836	6.000	4.402	$26.29	$17.43	$49.50	$68.30	$41.30	$51.52
Chicopee	4.928	5.849	8.100	8.782	2.232	3.071	34.49	18.83	416.80	262.90	31.18	32.71
Concord	9.049	7.377	9.331	8.947	6.469	3.227	33.59	37.30	61.50	50.20	78.07	52.15
Danvers	6.380	3.163	9.311	10.300	3.500	1.634	28.36	21.34	197.50	300.00	59.60	45.61
Hudson	6.529	6.482	11.746	10.932	2.954	2.812	34.52	25.06	195.50	122.80	47.84	37.58
Hull	16.401	12.763	17.543	14.823	7.590	4.511	33.00	26.41	49.10	30.80	36.27	50.75
Ipswich	11.665	10.806	11.665	11.001	....	....	33.34	28.75	....	....	54.36	50.33
Mansfield	8.162	7.702	12.184	11.365	3.783	3.925	47.45	30.36	113.10	109.40	48.47	45.71
Marblehead	9.780	9.298	10.586	11.313	5.270	4.471	27.11	23.49	60.90	96.20	75.29	63.20
Merrimac	5.729	6.769	12.813	13.057	4.551	4.699	39.82	21.76	572.30	380.20	47.37	41.00
North Attleborough	14.714	7.035	15.134	12.450	6.406	2.838	46.49	26.21	126.20	167.10	44.30	50.12
Peabody	12.747	4.427	12.692	10.600	13.100	2.609	30.00	27.58	127.50	229.80	32.87	67.12
Reading	8.446	9.184	13.474	11.790	4.383	4.280	28.76	27.51	57.10	102.50	48.45	49.01
Taunton	5.893	4.274	12.916	8.781	3.356	2.300	77.29	50.58	437.00	275.10	29.71	24.54
Holyoke	2.685	2.830	6.295	5.746	1.689	1.685	51.99	33.28	480.40	449.20	40.23	26.72
Middleborough	11.740	10.768	13.280	13.357	6.439	5.420	42.00	37.17	73.60	145.50	50.00	78.52
Wakefield	14.124	10.441	14.124	11.220	....	6.656	47.21	26.14	?	77.00	77.26	(1)
Westfield	5.051	4.022	5.721	6.900	3.860	2.466	80.05	27.36	111.90	162.40	19.13	31.67
Average — Holyoke out	7.742	5.786	11.077	10.305	3.615	2.583	$36.98	$27.13	$171.00	$162.20	$39.25	$40.55
Average — Holyoke in.	4.948	4.381	9.526	8.565	2.281	2.113	39.45	28.52	253.40	221.00	40.00	35.06

[1] Equipment out of use most of year.

Company	Average price per K.W.H. received for current sold (cents)										Operating income (dollars)							
	Total		Total—Excluding street lighting		Commercial light		Power		Street lighting		Per customer				Per K.W. capacity		Per K.W. capacity (Excluding street lighting income)	
											Light		Power					
	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1911	1915	1910	1915	1910	1915
Amesbury	6.004	4.304	5.290	4.438	11.671	12.374	2.626	2.178	11.788	9.805	$54.97	$36.08	$238.00	$230.39	$64.39	$35.41	$51.80	$32.78
Attleboro	5.097	5.013	4.768	4.672	10.586	10.125	2.945	2.775	8.347	8.443	51.76	39.22	445.62	394.14	89.14	80.10	38.26	25.59
Buzzard's Bay	†	7.012	†	6.282	†	8.868	†	4.712	22.770[1]	17.275	27.15[1]	24.00	20.00[1]	41.78	2.21 (62.46)[4]	24.96	1.96 (30.05)[4]	25.50
Gloucester	12.264	10.226	12.264	10.769	15.000	12.880	6.775	5.631	9.690	8.995	48.17	58.31	107.13	55.94	68.59	57.83	45.21	40.39
Great Barrington	8.456	8.702	8.513	9.284	14.758	14.568	2.900(?)	4.851	6.044	9.979	51.70	40.06	79.14	121.54	106.85	120.22	146.27	106.98
Lee	12.892	8.777	11.164	8.177	11.164	6.711	....	1.838	12.995	12.980	42.85	29.41	†	183.06	89.89	86.80	81.81	69.91
Leominster	5.808	4.045	5.805	3.642	14.380	11.380	2.240	2.505	6.808	5.779	38.81	31.31	138.92	476.05	36.67	97.84	40.17	32.09
Northampton	7.705	6.381	6.864	5.372	11.028	9.955	5.284	4.129	5.900	5.804	67.84	41.95	66.88	188.62	78.81	90.94	80.67	77.10
Plymouth	6.956	4.704	6.434	4.208	9.121	7.179	4.186	2.286	12.072	9.271	40.31	27.15	171.97	122.46	70.57	119.95	56.78	105.04
Quincy	10.997	8.185	12.900	6.697	16.176	12.438	5.170	3.921	7.119	8.575	84.77	97.76	318.76	287.84	78.57	70.97	61.49	55.22
Weymouth	5.969	4.805	5.478	4.586	14.349	6.861	2.940	2.286	11 116	12.820	78.66	80.96	272.17	662.20	68.69	88.56	57.17	84.63
Winchendon	5.479	4.968	5.750	4.622	5.750[2]	6.273	†	1.983	9.375	7.750	49.62	40.00	105.86	212.00	(123.80)[4]	84.80	98.80	65.68
Beverly	7.696	7.220	9.071	8.894	11.761	11.288	5.795	5.497	5.863	5.795	54.06	66.21	146.58	220.80	96.00	113.61	66.10	76.15
Citizens'	16.296	17.962	19.019	19.700	19.020	19.497	....	....	12.741	16.709	32.61	18.54	....	....	69.90	41.80	36.60	27.08
Newburyport	7.079	6.108	8.284	6.619	14.027	12.899	2.721	2.415	10.448	5.165	69.28	51.90	294.90	315.06	82.80	70.56	85.87	56.21
North Adams	2.835[1]	2.662	3.670[1]	3.450	10.550	6.469	2.275	2.268	5.210[1]	6.752	48.51	36.65	490.21	379.01	62.31	76.01	58.05	66.05
Vineyard	12.750[1]	7.608	10.740[1]	6.528	10.220[1]	6.709	10.760[1]	4.482	19.880[1]	17.800	39.46	28.57	480.75	131.89	36.19	34.68	23.06	28.89
Average	6.758	5.764	[illegible]	5.461	11.774	10.088	3.452	3.047	7.875 (7.560)[3]	7.875 (7.388)[3]	$45.46	$32.14	$260.00	$208.55	$61.93	$61.08	$49.22	$40.94

[1] For 1911. [2] Power included. [3] Buzzard's Bay, North Adams, and Vineyard out. [4] All current purchased at this date.

Municipality	Per capita								Per K.W. connected load			
	Total [1]		Total — Excluding sales to other companies		Light		Power		Light		Power	
	1910	1915	1910	1915	1910	1915	1910	1915	1911	1915	1911	1915
Braintree	$2.80	$2.83	$2.80	$2.83	$2.68	$2.62	$0.05	$0.21	?	?	$21.43	$15.24
Chicopee	1.35	1.60	1.35	1.60	1.05	1.11	0.18	0.41	?	?	(43.18)	?
Concord	4.26	5.80	4.26	5.80	3.67	4.80	0.28	0.65	$30.92	$33.65	50.00	35.90
Danvers	3.03	4.80	3.03	4.70	2.20	2.68	0.83	2.02	27.71	47.05	63.50	14.47
Hudson	3.20	3.10	3.20	3.10	2.21	2.25	0.81	0.70	25.00	32.53	25.66	17.50
Hull	13.11	21.16	12.84	21.15	12.47	19.37	0.12	1.47	27.34	27.71	17.87	9.10
Ipswich	1.70	3.05	1.70	2.62	1.41	2.30	....	....	?	?	....	....
Mansfield	3.18	3.96	3.14	3.95	2.44	2.97	0.70	0.98	?	?	12.62	15.50
Marblehead	4.10	4.99	4.10	4.99	3.77	4.28	0.33	0.71	?	?	13.60	16.79
Merrimac	4.20	3.80	4.20	3.80	1.34	1.81	2.86	1.99	38.75	40.73	40.00	25.83
North Attleborough	2.83	3.25	2.83	3.24	2.67	2.48	0.12	0.75	31.71	20.06	39.18	24.56
Peabody	2.04	3.32	2.04	3.29	1.68	1.79	0.32	1.46	20.23	24.56	16.00	26.73
Reading	4.16	4.25	3.85	4.15	3.27	3.59	0.53	0.49	30.97	27.24	24.17	29.70
Taunton	2.12	2.74	2.12	2.74	1.23	1.72	0.89	1.03	(44.65)	?	29.77	12.13
Holyoke	3.28	4.81	3.28	4.73	1.66	2.74	1.61	1.99	32.97	20.90	22.38	18.95
Middleborough	2.13	3.18	2.13	3.18	1.85	2.66	0.28	0.52	33.44	33.51	22.00	18.57
Wakefield	1.35	1.88	1.35	1.88	1.26	1.56	....	0.19	?	?	?	22.30
Westfield	1.69	2.58	1.69	2.58	1.16	1.57	0.48	1.01	?	?	45.09	19.74
Average — Holyoke out	$2.47	$3.26	$2.45	$3.24	$1.93	$2.35	$0.46	$0.82	$28.45	$28.96	$27.72	$17.00
Average — Holyoke in	2.66	3.61	2.65	3.57	1.86	2.44	0.74	1.09	29.98	25.09	24.60	17.82

[1] Includes all operating revenues, whether from sale of current or from other sources.

Company	Per capita												Per K.W. connected load					
	Total [1]		Total — Excluding street lighting		Total — Excluding street lighting and sales to other companies		Light		Power		Street lighting		Light		Power		Street lighting	
	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1910	1915	1911	1915	1911	1915	1911	1915
Amesbury	$4.34	$5.07	$3.43	$4.12	$3.43	$4.12	$1.45	$2.20	$1.85	$1.88	$0.91	$0.96	$48.29	$32.79	$23.92	$9.95	$296.41	$247.92
Attleboro	5.22	6.25	4.44	5.30	4.44	5.29	2.32	2.96	2.10	2.33	0.79	0.95	29.76	24.10	27.70	22.87	190.00	257.60
Buzzard's Bay	2.02[2]	2.45	1.24[2]	1.69	1.24	1.69	1.13	1.59	0.01	0.10	0.75	0.75	33.47	43.95	?	30.46	340.91	336.95
Gloucester	3.32	4.00	2.47	3.14	2.47	3.14	2.05	2.55	0.42	0.59	0.76	0.86	32.50	22.89	26.00	25.36	250.03	247.56
Great Barrington	4.44	5.30	3.89	4.70	3.62	4.70	2.93	3.32	0.68	1.38	0.55	0.56	33.95	33.42	25.54	14.42	316.50	279.01
Lee	2.25	3.00	1.79	2.43	1.79	2.43	1.79	1.68	....	0.75	0.49	0.57	29.08	21.98	....	23.65	352.00	457.99
Leominster	3.51	5.19	2.84	4.31	2.84	3.91	1.62	1.85	1.22	2.06	0.67	0.86	32.68	33.74	27.28	28.30	170.22	296.67
Northampton	4.54	4.58	3.72	4.26	3.62	4.16	3.01	2.62	0.52	1.29	0.82	0.72	43.24	30.33	24.68	24.58	104 28	249.04
Plymouth	3.12	4.48	2.62	3.87	2.62	3.72	1.69	2.58	0.93	1.15	0.50	0.61	22.75	28.93	21.52	11.71	406.16	388.88
Quincy	3.41	4.54	2.67	3.73	2.67	3.73	1.99	2.88	0.68	0.85	0.74	0.81	35.01	26.70	26.34	23.50	284.43	300.00
Weymouth	5.96	7.67	3.32	6.88	3.25	4.41	1.59	3.21	0.55	1.17	0.63	0.79	53.73	36.62	12.77	16.31	426.80	339.36
Winchendon	2.62	3.58	1.96	2.77	1.96	2.76	1.87	2.01	0.19	0.76	0.56	0.80	36.67	30.75	6.81	15.92	192 82	243.92
Beverly	4.61	6.24	3.28	4.53	2.99	3.89	2.50	3.21	0.31	0.59	1.33	1.91	30.72	34.61	34.91	44.95	211.27	209.75
Citizens'	3.58	3.63	2.32	2.37	2.32	2.37	2.32	2.37	....	....	1.16	1.26	51.26	47.25	....	....	186.44	225.80
Newburyport	2.80	3.47	1.93	2.57	1.93	2.57	1.34	1.59	0.57	0.89	0.81	0.90	54.43	45.12	37.47	34.31	220.30	229.34
North Adams	4.81	6.57	4.00	5.71	3.46	5.05	2.61	3.10	0.85	1.95	0.51	0.86	45.05	22.73	30.41	33.14	250.00	265.73
Vineyard	5.80	6.42	3.38	4.91	3.38	4.91	2.45	4.64	0.93	0.27	1.92	1.51	51.57	76.09	28.23	11.92	261.76	314.89
Average	$3.83	$4.94	$3.04	$4.03	$2.89	$3.78	$2.08	$2.63	$0.77	$1.11	$0.82	$0.98	$35.71	$29.07	$25.64	$21.22	$219.64	$260.37

[1] Includes all operating revenues, whether from sale of current or from other sources.

[2] For 1911.

NET INCOME AND CHARGES AGAINST INCOME—ACTUAL AND ESTIMATED (1914–1915)

Municipality	Apparent results of operation: Net operating income: Amount	Apparent results of operation: Net operating income: Per K.W.H. delivered [1] (cents)	Other items of income [2] (Profit and loss)	Depreciation: Amount paid	Depreciation: Per K.W.H. delivered [1] (cents)	Interest: Actually paid: Amount	Interest: Actually paid: Per K.W.H. delivered [1] (cents)	Interest: On total investment: Amount (@ 4%)	Interest: On total investment: Per K.W.H. delivered [1] (cents)
Braintree	$2,106.50	0.479	....	$4,381.72	1.002	$660.00	0.151	$6,297	1.440
Chicopee	7,049.38	.600	$774.79	9,310.39	.792	6,140.43	.522	12,600	1.068
Concord	6,137.99	.900	154.07	5,080.80?	.801	6,001.55	.878	6,860	1.000
Danvers	9,715.20	.480	....	4,947.34	.243	4,182.67	.200	6,660	.326
Hudson	4,929.13	1.095	249.96	2,968.94	.659	1,268.91	.288	3,979	.883
Hull	*2,156.58	*0.400	261.20	5,989.94	1.326	2,129.25	.471	7,904	1.530
Ipswich	1,825.58	.590	....	2,040.00	.648	2,528.00	.803	3,100	1.000
Mansfield	5,243.40	1.380	106.52	3,904.85	1.018	3,656.67	.956	4,416	1.150
Marblehead	3,576.05	.520	....	5,150.00	.749	2,826.66	.411	7,683	1.117
Merrimac	1,054.43	.700	....	963.34	.620	377.17	.243	923	.600
North Attleborough	6,431.10	1,180	....	4,089.26	.750	2,908.31	.533	5,452	1.000
Peabody	10,949.08	.633	290.65	5,848.42	.337	3,101.39	.179	7,729	.445
Reading	15,477.65	2.266	474.96	6,972.28	1.018	4,508.37	.658	9,354	1.370
Taunton	21,592.86	.720	....	17,522.73	.585	15,822.50	.528	17,978	.600
Holyoke	111,174.87	1.000	507.04	42,491.00	.373	20,492.00[3]	.180	48,960	.430
Middleborough	8,610.04	2.900	....	3,178.95	1.067	1,442.00[3]	.484	4,546	1.515
Wakefield	*1,423.37	*0.385	161.73	3,947.38	1.069	1,857.00[3]	.503	4,665	1.267
Westfield	8,009.13	.500	480.91	6,010.00	.377	2,731.00[3]	.171	6,807	.425
Total—Holyoke out	$109,117.57	0.730	$2,956.79	$92,306.34	0.615	$62,142.88	0.414	$116,963	0.780
Total—Holyoke in	220,292.44	.834	3,463.83	134,797.34	.511	82,634.88	.313	165,913	.630

* Loss — total, $3,579.95.

[1] "Delivered" corresponds to "sold" for the companies.

[2] Mostly jobbing income.

[3] That portion of total interest which electric plant cost bears to combined cost of gas and electric, — 53.5, 64.0, 41.8, and 51.0 per cent respectively.

Company	Net operating income		Other items of income[1] (Profit and loss)	Depreciation		Interest	
	Amount	Per K.W.H. sold		Amount paid	Per K.W.H. sold	Amount paid	Per K.W.H. sold
Amesbury	$21,338.61	2.440	$2,404.99	$2,000.00	0.228	$2,184.95	0.250
Attleboro	48,224.96	2.088	3,157.13	10,100.00	.429	3,003.41	.130
Buzzard's Bay	7,547.88	1.420	376.29	....	....	10,921.56	2.044
Gloucester	49,609.10	4.204	2,128.39	7,500.00	.634	3,719.89	.314
Great Barrington	18,957.46	3.447	380.90	....	....	764.70	.138
Lee	8,813.14	1.435	56.25	5,140.00	.837	1,868.50	.304
Leominster	23,717.39	1.050	1,204.35	3,407.60	.150	11,865.97	.525
Northampton	45,584.07	2.730	4,259.84	362.21	.022	6,252.31	.373
Plymouth	30,070.87	1.700	426.13	....	....	6,960.32	.381
Quincy	65,195.78	2.900	830.76	8,238.66	.366	7,734.84	.343
Weymouth	36,944.25	1.680	2,156.83	....	....	6,846.58	.313
Winchendon	7,199.88	1.700	1,021.64	....	....	6,654.92	1.618
Beverly	84,593.30	3.836	941.25	12,871.22	.584	27.00[2]	.001
Citizens'	1,438.24	2.247	324.00	3,183.99	4.979	1,061.00[2]	1.659
Newburyport	23,531.66	2.350	360.00	....	....	2,259.00[2]	.223
North Adams	66,240.22	1.600	2,116.00	3,509.93	.085	11,222.00[2]	.270
Vineyard	5,292.84	1.640	37.00	....	....	6,548.00[2]	2.033
Total	$544,299.65	2.227	$22,221.75	$56,313.61	0.234	$90,094.47	0.369
Total — Street lighting out	279,658.38	1.144					

[1] Mostly jobbing income.

[2] Computed as that proportion of the total interest which cost of electric plant bears to combined cost of gas and electric, — 58.0, 61.3, 59.5, 60.0, and 82.3 per cent respectively.

Municipality	*Taxes lost by municipalities (@ 0.428 cents per K.W.H. delivered)*	*Other cost items*	*Total charges against income (actual and estimated)*	*Real cost (?) of street lighting*			*Divergence from average street lighting rate charged by companies (7.575 cents)*	*Additional interest which would be paid by companies of same size*	
				Amount [1] (total loss)	*No. K.W.H. used*	*Per K.W.H. used (cents)*		*Amount (@ 1% on total investment)*	*Per K.W.H. used for street lighting (cents)*
Braintree	$1,872	$602.57	$13,154	11,048	143,430	7.704	+ 0.129	$1,574	1.100
Chicopee	5,031	....	26,941	19,117	392,089	4.800	— 2.775	3,149	.800
Concord	2,925	459.54	15,325	9,033	190,710	4.730	— 2.845	1,715	.900
Danvers	8,715	....	20,332	10,617	333,108	3.200	— 4.375	1,665	.500
Hudson	1,928	59.79	8,935	3,754	92,178	4.070	— 3.515	995	1.080
Hull	1,933	458.94	16,286	18,182	77,646	23.430	+ 15.855	1,976	2.546
Ipswich	1,347	285.01	6,770	4,944	142,520	3.457	— 4.120	775	.542
Mansfield	1,641	....	9,962	4,610	86,904	5.300	— 2.275	1,104	1.270
Marblehead	2,841	172.72	15,847	12,271	279,064	4.380	— 3.195	1,921	.685
Merrimac	666	89.92	2,642	1,588	37,435	4.250	— 3.325	192	.550
North Attleborough	2,333	....	11,874	5,443	110,510	4.950	— 2.625	1,363	1.230
Peabody	7,423	....	21,000	9,760	273,038	3.600	— 3.975	1,933	.708
Reading	2,922	166.40	19,414	3462	156,997	2.163	— 5.412	2,338	1.490
Taunton	12,816	4,676.73	52,993	31,400	673,168	4.665	— 2.910	4,494	.670
Holyoke	48,768	626.40	140,845	29,163	1,058,500	2.750	— 4.825	12,240	1.113
Middleborough	1,275	936.41	9,986	1,326	42,658	3.100	— 4.475	1,136	2.640
Wakefield	1,580	11.81	10,204	11,467	154,797	7.400	— .175	1,166	.752
Westfield	6,816	176.26	19,809	11,319	411,536	2.750	— 4.825	1,702	.415
Total — Holyoke out	$64,200	$8,096.10	$281,555	$169,481	3,597,788	4.710	— 2.865	$29,288	0.815
Total — Holyoke in	112,936	8,722.50	422,400	198,644	4,656,288	4.265	— 3.310	41,477	.900

[1] The difference between total charges (actual and estimated), plus operating deficit, and the total available income (including P. and L. income). No allowance made for free quarters, etc.

DISPOSAL OF NET INCOME (*concluded*)

Company	Dividends			Other cost items	Balance		Capital stock
	Amount paid	Rate	Per K.W.H. sold (cents)	Amount	Surplus	Deficit	
Amesbury	$18,800	8%	2.148	$1,661.65	....	$903.00	$235,000
Attleboro	33,000	12	1.431	1,489.48	$3,789.20	....	275,000
Buzzard's Bay	....	....	....	18.16	....	3,015.55	11,000
Gloucester	20,984	8	1.774	523.03	19,010.57	....	314,200
Great Barrington	10,625	8½	1.921	196.15	7,752.51	....	125,000
Lee	1,500	5	.244	....	160.89	....	30,000
Leominster	8,100	7½	.358	2,265.71	....	717.54	220,000
Northampton	37,568	32	2.240	4,744.46	916.93	....	117,400
Plymouth	15,300	8½	.838	3,701.78	4,534.90	....	180,000
Quincy	45,000	15	1.996	3,582.54	1,470.50	....	300,000
Weymouth	30,000	10	1.370	3,997.54	....	1,743.04	300,000
Winchendon	....	....	....	170.00	1,296.60	....	12,000
Beverly	63,525[1]	12	2.906	16.80	9,094.53	....	398,800[4]
Citizens'	....	....	....	158.13	....	2,640.77	15,900[4]
Newburyport	16,188[1]	8	1.595	96.00	5,348.81	....	169,600[4]
North Adams	53,280[1]	21	1.282	638.00	....	293.71	240,000[4]
Vineyard	....	....	....	155.45	....	1,373.39	20,700[4]
Total	$353,870	11.94 (6.6)[2] (10.3)[3]	1.448	$23,414.78	$53,575.44	$10,687.00	$2,964,600

[1] Computed as that proportion of total dividends which the net income of the electric plant bears the combined net income of gas and electric, —77.0, 71.0, and 74.0 per cent respectively. [2] On total investment. [3] On stock and premiums. [4] Computed as explained above, p. 427.

Municipality	Number of employees [1]		No. K.W.H. supplied per employee		Gross income per employee		Company	Number of employees [1]		No. K.W.H. sold per employee		Gross income per employee		Gross income per employee (Excluding street lighting)	
	1910	1915	1910	1915	1910	1915		1910	1915	1910	1915	1910	1915	1910	1915
Braintree	9	12	39,280	66,452	$2,324	$2,306	Amesbury	9	15	77,060	58,260	$4,772	$3,471	$3,711	$3,314
Chicopee	718	18 [4]	86,000	78,470	1,900	2,097	Attleboro	14	7 17 [6]	186,000	125,225	5,945	5,200	5,200	5,708
Concord	9	14	49,000	48,230	3,066	3,770	Buzzard's Bay	2 [3]	7 24	7 15,600	22,510	2,115	1,561	1,308	1,077
Danvers	11	13	89,730	156,630	2,000	4,144	Gloucester	13	7 32	87,740	36,200	7,092	2,516	5,480	3,000
Hudson	9	11 [4]	41,640	41,000	2,400	2,221	Great Barrington	7	8	51,970	69,154	3,800	3,015	4,540	5,245
Hull	14 [2]	715	15,178	30,108	1,300	1,580	Lee	5	54	28,500	13,280	3,270	4,540	2,567	2,702
Ipswich	7 [4]	104	51,000	31,428	1,396	1,512	Leominster	12	28 [2]	94,120	87,000	5,547	3,520	4,500	2,920
Mansfield	6	7	50,070	54,510	2,747	3,285	Northampton	17	24 [2]	65,420	69,385	5,190	4,490	4,280	3,540
Marblehead	13	14	61,863	69,100	2,516	3,710	Plymouth	11	7 18	66,400	101,400	4,820	4,770	3,880	4,128
Merrimac	3	2	66,400	77,700	3,072	3,904	Quincy	28	39	89,120	55,240	4,000	4,780	3,110	3,900
North Attleborough	11	10	35,210	54,510	2,457	3,057	Weymouth	14	26	60,240	94,280	3,044	4,121	3,081	3,702
Peabody	716	13	84,000	98,800	2,008	3,025	Winchendon	4	4	48,800	10,800	2,714	5,251	2,770	4,100
Reading	8	14	85,070	42,800	4,038	3,800									
Taunton	19	26	99,190	89,200	3,220	3,755									
							Beverly	127	7 18	110,200	115,080	5,872	5,324	5,160	5,170
Holyoke	30	69	208,610	128,781	4,849	4,719	Citizens'	4	4	15,260	16,000	2,508	2,797	1,648	1,870
Middleborough	9 [4]	12 [4]	21,074	24,220	1,944	2,280	Newburyport	9	7 11	70,200	92,220	5,104	5,780	3,618	4,270
Wakefield	7 [4]	7 [4]	26,477	52,726	2,207	2,570	North Adams	26	21	126,000	128,400	4,800	5,000	3,572	4,280
Westfield	12 [4]	194	64,400	33,280	2,080	2,000	Vineyard	6	7 20	21,000	23,210	2,014	1,258	2,460	1,267
Total—Holyoke out	171	220	49,071	35,044	$2,477	$2,118	Total	194	318	74,230	73,077	$4,230	$4,280	$3,201	$3,252
Average	10.2	12.0	....	....	....	....	Average	11.4	12.4	....	....	....	....	....	....
Corrected for 1915	....	240 [5]	....	32,400	....	2,200	Corrected for 1915	....	296 [6]	....	32,005	....	4,285	....	3,202
Total—Holyoke in	213	332	76,282	90,250	2,201	2,200									

[1] Returns very unsatisfactory. [2] Extra help as needed. [3] Corrected by careful analysis. [4] No clerks, etc., returned. [5] Work half time. [6] One general officer.

B. STATISTICS OF PURCHASING PLANTS

Municipality	No. K.W.H. bought	Used by plant and unaccounted for		Total current delivered	Commercial and domestic lighting	Public buildings	Street lighting	Power	Other companies
		No. K.W.H.	Per cent of total	No. K.W.H.	No. K.W.H. sold	No. K.W.H. sold	No. K.W.H. supplied	No. K.W.H. sold	No. K.W.H. sold
Ashburnham	88,434	13,175	15.0	75,309	33,895	1,245	13,150	21,971	....
Belmont	492,321	102,613	21.3	379,708	259,126	5,582	104,007	10,391	....
Boylston	22,902	7,026	30.5	15,876	6,895	602	8,081	406	....
Georgetown	90,450	19,530	21.5	70,930	22,426	1,176	25,986	19,420	1,972
Groton	74,390	18,231	24.5	56,159	26,577	3,085	25,745	751	....
Groveland	89,320	19,050	21.4	70,340	30,645	631	38,159	905	....
Hingham	454,097	92,585	20.4	361,512	179,634	3,647	97,369	80,862	....
Holden	80,660	19,249	23.8	61,411	41,208	2,140	10,973	2,460	4,570
Littleton	48,590	13,989	29.0	34,601	12,968	1,225	10,407	10,001	....
Lunenburg	33,346	14,066	41.6	19,780	11,569	313	5,816	2,077	....
Middleton	18,843	3,617	19.2	15,226	4,567	736	9,336	488	....
Norwood	1,484,000	154,418	10.4	1,329,582	336,061	8,308	162,140	823,073	....
Paxton	19,910	5,605	28.2	14,305	7,865	464	3,840	2,136	....
Princeton	35,570	9,239	26.0	26,541	9,469	20	13,152	....	....
Rowley	41,130	9,217	22.5	31,913	14,941	538	13,126	3,008	....
Shrewsbury	167,160	35,050	21.0	132,050	65,937	4,000	60,000	2,113	....
South Hadley	312,628	137,905	44.0	174,723	81,530	2,416	70,477	19,800	440
Sterling	72,000	11,826	16.4	60,174	28,533	803	14,220	16,618	....
Templeton	129,263	44,284	34.3	84,979	49,909	748	28,280	6,042	....
Wellesley	796,750	122,288	15.4	674,462	359,302	12,425	164,791	137,964	....
West Boylston	83,626	15,705	19.0	68,121	27,598	2,103	38,420	....	....
Total — Norwood out	3,143,450	715,210	22.7	2,428,240	1,279,594	44,354	760,908	337,475	6,982
Average	157,173	....	....	121,412	63,976	....	38,045	16,874	349
Total — Norwood in	4,627,450	860,623	18.8	3,757,822	1,615,585	52,662	923,048	1,160,548	....
Average	220,355	....	....	178,944	77,000	....	43,954	55,264	....

Company	No. K.W.H. bought	Used by plant and unaccounted for		Current sold	Commercial and domestic lighting	Street lighting	Power	Other companies
		No. K.W.H.	Per cent of total	No. K.W.H.	No. K.W.H. sold	No. K.W.H. sold	No. K.W.H. sold	No. K.W.H. sold
Ayer	237,310	39,722	16.7	199,488	65,600	30,530	28,968	74,390
Blackstone	147,584	37,765	25.5	109,819	36,349	48,014	25,456	....
Franklin	917,590	340,410	37.1	577,180	194,022	98,295	284,863	....
Harvard	35,730	10,612	30.0	25,118	10,616	8,898	5,604	....
Ludlow	246,959	61,538	25.0	185,421	78,063	42,641	60,104	4,793
Manchester	267,900	72,971	28.4	191,929	172,803	....	19,126	....
Milford	490,831	93,494	19.0	397,337	214,809	90,096	92,432	....
Mill River	110,810	19,988	18.0	90,822	24,985	11,807	54,080	....
North Brookfield	266,184	48,162	18.1	218,022	29,599	16,480	171,943	....
Provincetown	112,668	25,680	22.7	86,988	67,443	18,129	1,416	....
Randolph	424,600	76,739	18.1	347,861	148,587	47,449	151,825	....
Shirley	72,225	26,305	36.5	45,920	21,815	12,578	11,527	....
Spencer	79,720	9,541	12.0	70,179	21,559	43,300	5,320	....
Sunderland	29,444	7,862	26.7	21,582	10,372	7,811	3,399	....
Ware	468,749	82,570	17.6	386,179	167,834	149,579	68,766	....
Williamstown	359,133	92,950	26.0	267,183	190,904	51,880	23,399	....
Total	4,267,437	1,046,409	24.5	3,221,028	1,455,310	677,307	1,008,228	79,183
Average	266,715	61,553	....	201,314	90,957	42,332	63,014	4,658

Municipality	Lighting			Power			Total light and power	Maximum station load (K. W.)	Maximum station load on day of least output (K. W.)	Load factor
	Commercial	Municipal street	Total	Commercial	Municipal	Total				
Ashburnham	125.00	5.06	130.06	17.00	15.00	32.00	162.06	?	?	?
Belmont	1,587.00	40.98	1,627.98	(?) 62.00	....	62.00	1,689.98	?	?	?
Boylston	27.00	4.36	31.30	....	....	....	31.30	?	?	?
Georgetown	78.41	10.01	88.42	(?) 43.75	....	43.75	132.169	?	?	?
Groton	146.90	11.10	158.00	11.50	2.75	14.25	172.25	30 A.	6 A.	?
Groveland	199.98	20.48	219.98	4.00	....	4.00	223.975	?	?	?
Hingham	912.10	33.08	945.18	176.61	2.24	178.85	1,124.028	371	162	14
Holden	80.00	11.20	91.12	5.78	....	5.78	96.902	?	?	?
Littleton	60.50	5.06	65.56	29.00	21.00	50.00	115.560	?	?	?
Lunenburg	?	2.68	?	?	....	?	?	?	?	?
Middleton	20.00	4.18	24.18	....	....	....	24.18	?	?	?
Norwood	1,223.00	40.90	1,263.90	826.00	183.00	1,009.00	2,263.90	5,800 (K.W.H.)	2,100 (K.W.H.)	?
Paxton	1.92	2.67	4.59	?	....	?	?	?	?	?
Princeton	?	9.90	?	....	....	....	?	?	?	?
Rowley	56.00	9.00	65.00	13.68	....	(?) 13.68	(?) 78.682	?	?	?
Shrewsbury	345.00	17.60	362.60	30.00	....	30.00	392.600	?	?	?
South Hadley	303.44	19.48	322.92	90.63	....	90.63	413.550	?	?	?
Sterling	61.00	4.88	65.88	(?) 90.00	....	90.00	155.875	512 (K.W.H.)	136 (K.W.H.)	?
Templeton	205.00	15.96	220.96	59.30	....	59.30	280.260	?	?	?
Wellesley	1,207.70	52.90	1,260.60	55.10	114.70	169.80	1,430.400	343	78	26.5
West Boylston	103.28	10.68	113.96	....	....	....	113.960	30	11	(?) 31.9
Total — Norwood out	5,520.23	291.48	5,798.31	688.35	155.69	844.04	6,637.551			
Average	(18) 306.69	(20) 14.57	....	....	....	(20) 42.20	(17) 390.45			
Total — Norwood in	6,743.23	332.38	7,062.21	1,514.35	338.69	1,853.04	8,901.551			

CONNECTED LOAD (1915)

Company	Lighting			Power			Total light and power	Maximum station load (K.W.)	Maximum station load on day of least output (K.W.)	Load factor
	Commercial	Municipal street	Total	Commercial	Municipal	Total				
Ayer	306.00	9.41	405.41	64.13	....	64.13	469.530	116	40	22.
Blackstone	174.23	12.65	186.88	89.15	....	89.15	276.030	?	?	
Franklin	893.17	23.94	916.91	815.00	....	815.00	1,731.905	403	170	28.
Harvard	97.70	2.44	100.14	43.15	....	43.15	143.290	13	6	31.4
Ludlow	66.40	7.00	73.40	54.80	....	54.80	128.200	?	?	
Manchester	732.30	....	732.30	49.20	37.30	86.50	816.800	215	60	14.2
Milford	795.30	20.15	815.45	226.63	15.00	241.63	1,057.075	266	(88) 192	21.1
Mill River	196.98	4.68	201.54	99.00	....	99.00	300.540	?	?	
North Brookfield	205.11	4.53	209.63	212.61	....	212.61	422.240	?	?	
Provincetown	281.12	5.24	286.36	.75	....	.75	287.110	68	44	19.
Randolph	475.04	24.60	499.64	246.90	....	246.90	746.540	147	(29) ?	33.
Shirley	73.53	4.96	78.49	30.50	....	30.50	108.990	?	?	
Spencer	136.27	19.75	156.02	34.09	....	34.09	190.108	51	?	19.2
Sunderland	?	1.26	?	18.09	....	18.09	?	?	?	
Ware	354.43	38.75	393.18	217.09	....	217.09	610.270	?	?	
Williamstown	421.90	14.80	436.70	62.12	3.75	65.87	502.574	?	?	
Total	5,299.45	194.15	5,493.15	2,253.21	56.05	2,319.26	7,793.302	....	....	23.4[1]
Average	(15) 353.30	(15) 13.00	(15)366.14	....	....	(16) 145.00	(15) 520.000			

[1] Arithmetical average of 8 plants — very uncertain.

Municipality	Number of customers			Population of district served	Lines (Length in feet)			Area of territory served	Length of roads	Number of poles	Line Transformers								
	Total	Light	Power		Total	Length of streets with overhead lines	Street lighting lines				Number	Total capacity (K.W.)	Average size (K.W.)	Grouped according to capacity					
														1 K.W. or less	1½ to 3 K.W.	5 K.W.	7½ to 10 K.W.	Over 10 K.W.
Ashburnham	154	176	1	4,059	122,000	70,497	32,420	29.15	105.	251	96	220	22.0	4	4	4	1	1
Belmont	1,202	1,202	10	5,051	675,296	165,261	225,495	4.59	30.20	1,078	80	624	6.4	3	6	15	12	9
Boylston	98	97	6	703	171,585	44,760	63,190	15.98	31.50	491	34	38	1.1	21	3	3	1	1
Georgetown	189	189	15	2,259	815,259	68,196	199,200	13.10	22.	628	38	74	1.9	23	6	4	1	1
Groton	111	111	6	2,259	696,290	124,950	141,280	32.58	71.	513	38	82	1.3	23	6	4	1	1
Groveland	183	187	6	2,577	880,830	94,950	149,280	5.90	20.	417	38	76	1.3	23	6	4	1	1
Hingham	703	703	38	5,354	1,189,994	379,172	389,405	23.48	84.	1,394	100	280	2.5	34	24	18	14	10
Holden	170	168	9	2,514	429,875	110,280	122,695	25.50	57.	397	62	103	2.3	37	11	7	4	3
Littleton	108	104	4	1,295	228,815	76,144	91,500	15.46	26.	195	33	84	2.5	17	11	1	1	1
Lunenburg	128	126	12	1,810	284,984	?	35,540	26.82	30.	230	30	69	2.4	16	8	4	1	1
Middleton	61	60	2	1,800	95,100	17,178	65,020	14.27	21.	196	6	14	2.5	3	1	2	1	0
Norwood	1,257	1,225	25	10,977	965,871	227,978	251,260	10.47	40.	1,738	145	609	6.8	44	25	15	25	36
Paxton	46	46	2	471	128,140	50,000	?	14.87	27.	207	14	32	1.6	8	6	0	0	0
Princeton	87	82	5	800	278,300	70,000	?	25.47	77.	321	26	57	0.3	15	3	1	1	0
Rowley	34	31	19	1,421	24,472	?	?	19.01	40.	226	12	23	2.3	6	1	1	1	1
Shrewsbury	420	388	62	2,794	686,000	170,000	221,000	30.76	82.	1,025	87	138	2.0	19	8	3	2	2
South Hadley	448	445	25	5,179	361,188	65,972	122,918	37.76	80.	967	114	277	2.4	32	14	4	4	3
Sterling	95	95	12	1,408	286,796	152,740	41,520	20.56	61.	294	13	22	1.5	5	1	1	0	0
Templeton	270	263	27	4,051	276,892	92,608	202,641	11.49	35.50	573	61	159	2.9	23	4	3	1	1
Wellesley	369	366	25	6,488	1,021,800	213,000	340,800	10.05	55.	2,045	14	205	8.2	23	11	17	16	0
West Boylston	130	130	....	1,813	348,540	104,760	107,400	13.49	22.	365	28	69	1.0	24	7	1	0	0
Total — Norwood out	5,776	5,723	339	69,931	7,895,221 (1495 m.)	276,900 (256.7 m.)	2,621,676 (800 m.)	326.05	1180.20	15,977	900	2,736	3.09	497	217	115	67	68
Average	289	286	15	2,973	72.9 m.	11.4 m.	19.4 m.	13.60	49.0	706								
Total — Norwood in	7,009	6,943	362	64,259	8,880,530	2,264,578	2,713,227	402.51	1,322	17,699	1,045	5,705	5.45	511	262	135	80	57
											Percentage of different sizes — Norwood out			52.9	24.1	12.8	7.2	4.8

Company	Number of customers: Total	Number of customers: Light	Number of customers: Power	Population of district served	Lines (length in feet): Total length	Lines (length in feet): Length of streets with overhead lines	Lines (length in feet): Street lighting lines	Area of territory served (sq.m.)	Length of roads	Number of poles	Line Transformers: Number	Line Transformers: Total capacity (K.W.)	Line Transformers: Average size (K.W.)	Grouped according to capacity: 1 K.W. or less	Grouped according to capacity: 1+ to 3 K.W.	Grouped according to capacity: 3+ to 5 K.W.	Grouped according to capacity: 5+ to 10 K.W.	Grouped according to capacity: Over 10 K.W.
Ayer	824	808	16	2,779	240,822	54,899	74,196	8.81	80.	592	98	168	4.5	1	17	18	6	2
Blackstone	185	181	8	5,889	356,072	82,500	198,278	15.89	52.	568	48	210	4.6	9	19	12	6	6
Franklin	765	758	58	8,876	689,537	117,712	150,900	44.88	129.	1,396	105	465	4.4	18	38	33	16	5
Harvard	86	75	10	1,104	356,167	72,987	65,020	26.86	68.	712	25	78	3.1	8	8	6	5	0
Ludlow	482	472	7	6,251	262,282	87,900	87,170	27.14	70.	686	81	189	5.5	4	9	11	4	8
Manchester	467	463	22	2,948	133,724[4]	94,036[3]	....	7.72	17.50	125	41	438	10.1	1	1	12	9	18
Milford	721	651	70	16,347	554,383	97,877	137,650	19.90	96.60	1,358	68	451	7.8	8	15	20	10	10
Mill River	167	160	7	3,118	220,818	45,322	81,946	25.88	42.	496	25	147	5.8	1	8	10	3	1
North Brookfield	294	291	7	2,947	336,789	46,000	110,782	21.11	67.	625	53	348	6.5	25	10	8	1	8
Provincetown	560	580	....	4,295	249,384	56,760	60,840	8.85	12.	379	42	132	3.1	22	11	1	6	2
Randolph	710	710	37	7,680	734,871	155,985	251,318	17.37	50.75	1,118	51	294	5.8	12	20	7	4	8
Shirley	127	127	1	2,251	309,881	57,768	92,640	15.81	42.	489	18	95	5.3	2	6	5	3	2
Spencer	128	110	18	5,994	209,766	70,415	105,972	33.15	92.	922	15	67	4.5	2	5	7	2	0
Sunderland	89	83	6	1,278	123,068	54,200	17,282	14.86	38.76	381	32	88	2.8	11	12	5	4	0
Ware	549	545	21	12,942	696,987	136,720	258,960	68.05	177.82	1,945	104	677	6.5	29	28	15	26	8
Williamstown	456	438	17	3,981	318,802	61,855	80,829	46.74	67.	318	67	392	5.9	21	15	15	6	10
Total	6,021[1]	5,861	305	87,480[2]	5,804,168 (1,100 m.)	1,250,386 (236.3 m.)	1,828,481 (345.8 m.)	401.01	1,051.42	12,005	752	4,208	5.60	169	218	180	105	86
Average	876	845	18	5,487	68.7 m.	14.8 m.	(15) 22.0 m.	25.08	65.7	750 (722)[4]	Percentage of different sizes			22.5	28.4	24.0	14.0	11.2

[1] Including 765 in other towns, of which the plant at Franklin has 255. [2] Of these, excluding Franklin for which data cannot be separated, 9,207 are in outside districts. Excluding Franklin, also, the population of the home districts is 69,397. [3] All underground construction.
[4] Manchester out. All underground lines.

Municipal	Total investment [1]	Gross plant cost (total investment) [2]	Plant account (depreciated)	New construction during year	Debt		Debt payment [3] (1914-1915)	Total appropriations from tax levy for construction, debt payment, etc.	[redacted] sheets	
					Bonds	Notes			Assets	Liabilities
Ashburnham	$17,490	$18,327	$17,267	$1,595	....	$6,500	$1,000	$9,500	$30,735	$18,530
Belmont	65,293	57,053	49,926	2,602	$21,500	4,000	1,500	45,043	66,092	70,696
Boylston	11,118	11,777	11,007	586	....	7,000	1,100	4,018	12,773	11,842
Georgetown	20,000	18,960	17,503	(?) 3,067	18,000	....	1,000	3,000	24,976	21,540
Groton	26,072	28,018	25,328	2,139	....	7,500	1,500	20,782	30,222	28,340
Groveland	17,550	17,385	17,324	1,278	....	11,500	500	6,950	18,918	18,691
Hingham	63,916	71,648	59,193	2,700	....	....	....	63,916	67,043	63,974
Holden	20,498	23,678	20,824	4,618	....	8,600	1,300	11,598	26,205	20,796
Littleton	22,819	21,813	20,675	4,331	14,000	....	500	9,819	26,027	25,403
Lunenburg	16,000	16,419	16,419	....	....	16,000	....	605	17,813	17,072
Middleton	6,793	6,743	6,580	1,393	....	4,500	....	2,293	7,346	6,809
Norwood	71,592	98,213	81,249	5,526	....	30,000	2,500	31,962	96,021	64,781
Paxton	5,989	7,845	7,630	607	....	4,500	500	1,489	8,279	6,264
Princeton	15,734	16,671	15,313	171	....	13,000	1,000	2,734	18,288	16,976
Rowley	20,191	21,459	19,352	1,507	....	12,080	480	6,111	22,064	20,651
Shrewsbury	43,869	46,726	41,555	4,406	....	18,300	1,500	23,569	49,792	46,193
South Hadley	40,000	35,543	34,602	3,253	40,000	....	2,000	....	43,269	44,056
Sterling	22,825	19,301	18,122	2,416	....	12,100	2,500	12,125	23,837	24,499
Templeton	33,435	32,691	30,110	1,121	....	16,463	717	17,665	36,141	34,691
Wellesley	77,569	84,036	70,964	6,717	6,000	....	3,000	74,569	92,125	90,649
West Boylston	28,053	28,934	24,487	2,805	....	9,000	1,000	19,053	29,750	28,072
Total — Norwood out	$575,420	$579,508	$517,579	$48,041	$99,500	$158,663	$20,997	$340,394	$641,720	$605,842
Total — Norwood in	646,972	677,721	598,921	53,567		183,663	23,497	372,946	738,341	670,623

[1] As computed by the Board [2] Used by author. [3] A sinking fund payment of $230 was also made.

Company	Cost of plant (investment)	Assessed valuation	New construction during year	Capital Liabilities				Balance sheets	
				Total	Stock	Bonds	Notes	Assets	Liabilities
Ayer	$61,786	$29,175	$6,277	$62,500	$30,000	$8,500	$24,000	$69,067	$67,816
Blackstone	27,702	15,000	5,622	28,630 [1]	(40,000) [1]	....	(14,000) [1]	(59,692) [2]	(67,985) [2]
Franklin	66,975	58,225	10,428	69,000	40,000	....	29,000	96,113	91,258
Harvard	34,583	13,875	2,729	35,000	12,000	....	23,000	35,355	38,221
Ludlow	25,393	24,423	4,394	28,500	21,000	....	7,500	31,350	31,013
Manchester	205,678	109,000	7,600	185,800	173,800	....	12,000	215,135	208,976
Milford	108,823	93,000	10,947	105,800	40,000	40,000	25,800	123,072	120,612
Mill River	36,161	20,000	1,856	35,750	15,000	12,000	8,750	38,017	36,460
North Brookfield	50,114	22,400	6,590	61,000	60,000	....	1,000	64,218	63,778
Provincetown	60,907	37,921	6,367	64,000	20,000	....	14,000	69,370	65,388
Randolph	121,621 / 20,022	41,000	57,505	176,500	40,000	90,000	46,500	202,161	201,751
Shirley	26,385	27,323	4,991	23,000	12,700	....	10,300	30,240	30,240
Spencer	47,243	? 13,000	5,593	50,250 [1]	(97,500) [1]	(85,000) [1]	(18,500) [1]	(217,587) [2]	(215,037) [2]
Sunderland	10,316	5,000	3,796	15,000	11,000	....	4,000	10,618	15,553
Ware	175,996	62,400	13,732	206,500	132,000	....	74,500	218,620	212,861
Williamstown	80,133	? 35,000	4,622	30,600 [1]	(40,000) [1]	....	(31,500) [1]	(86,160) [2]	(78,849) [2]
Total	$1,110,738	$606,742	$153,039	$1,178,830	($720,000) (13 plants)	....	($317,350) (13 plants)	$1,203,936 (13 plants)	$1,183,432 (13 plants)

[1] Composite plants; for the total capital liabilities that proportion of the aggregate was taken which the electric plant cost bears to the combined cost of gas and electric plant, — 54.4, 24.1, and 42.4 per cent respectively.
[2] Composite plants: no satisfactory separation can be made.

(1914–1915)

Municipality	Expenses at station ("manufactory")	Current purchased and sold					Wages		Repairs and renewals of lines, lamps, meters, motors, etc.		Distribution, tools and equipment		Total cost of distribution	
		No. K.W.H. bought	No. K.W.H. "sold"	Amount paid for current	Per K.W.H. bought (cents)	Per K.W.H. "sold" (cents)	Amount paid	Per K.W.H. "sold" (cents)	Amount paid	Per K.W.H. "sold" (cents)	Amount paid	Per K.W.H. "sold" (cents)	Amount	Per K.W.H. "sold" (cents)
Ashburnham	....	83,484	75,309	$2,218.48	2.507	2.983	$511	0.679	....	....	....	....	$511.33	0.679
Belmont	....	482,321	379,708	17,363.55	3.600	4.573	1,353	.356	$8,380	2.202	$944	0.248	10,057.05	2.807
Boylston	$2.50	22,902	15,876	672.65	2.500	3.607	150	.945	51	.321	....	....	200.98	1.266
Georgetown	1.15	90,450	70,330	3,114.65	3.443	4.391	....	....	316	.446	....	....	316.13	0.446
Groton	....	74,390	56,159	2,257.00	3.034	4.019	420	.748	916	1.631	....	....	1,335.94	2.379
Groveland	....	88,390	70,340	3,048.20	3.410	4.334	...	....	571	.812	....	....	571.21	0.812
Hingham	....	454,097	361,512	16,340.18	3.598	4.520	1,491	.412	1,335	.369	899	.249	3,725.45	1.031
Holden	48.46	80,650	61,411	2,016.50	2.500	3.284	....	....	376	.612	37	.061	413.13	0.673
Littleton	....	48,590	34,601	2,317.23	4.771	6.697	357	1.032	36	.104	78	.225	471.20	1.362
Lunenburg	....	33,846	19,780	846.16	2.500	4.279	91	.460	58	.291	14	.070	162.60	0.822
Middleton	....	18,843	15,226	1,130.58	6.000	7.425	....	....	96	.642	....	....	97.76	0.642
Norwood	25.28	1,484,000	1,329,582	28,504.40	1.921	2.144	1,129	.085	2,420	.182	453	.034	4,002.01	0.301
Paxton	....	19,910	14,305	597.30	3.000	4.175	110	.770	3	.024	....	....	113.58	0.794
Princeton	....	36,870	26,641	921.74	2.500	3.460	110	.414	172	.646	....	....	282.39	1.060
Rowley	....	41,130	31,913	2,467.80	6.000	7.733	45	.140	202	.634	....	.001	247.67	0.775
Shrewsbury	....	167,100	132,050	4,010.40	2.460	3.037	1,033	.782	352	.266	....	....	1,384.36	1.048
South Hadley	171.84	312,528	174,723	6,692.58	2.141	3.830	322	.184	5,064	2.898	....	....	5,385.35	3.082
Sterling	....	72,000	60,174	1,800.00	2.500	2.991	239	.398	36	.060	89	.136	351.79	0.585
Templeton	....	129,263	84,979	3,231.55	2.500	3.803	1,533	1.810	402	.473	24	.028	1,964.31	2.312
Wellesley	1,446.78	796,750	674,462	18,536.70	2.364	2.793	1,589	.236	5,667	.840	69	.009	7,315.71	1.085
West Boylston	....	83,526	68,121	2,095.65	2.500	3.076	692	1.017	149	.219	21	.031	863.06	1.267
Total—Norwood out	$1,670.73	3,143,450	2,428,240	$91,677.97	2.930	3.780	$10,047	0.490	$24,165	1.000	$2,159	0.090	$38,370.99	1.500
Average	....	157,173	121,412	....	....	....	....	....	....	....	....	....	....	....
Total—Norwood in	1,696.01	4,627,450	3,757,822	120,382.37	2.601	3.204	11,176	0.297	26,585	0.707	2,612	0.070	40,378.00	1.074
Average	....	220,355	178,944	....	....	....	....	....	....	....	....	....	....	....

(1914–1915)

Company	Expenses at station ("manufacture")	Current purchased and sold					Wages		Repairs and renewals of lines, lamps, meters, motors, etc.		Distribution, tools and equipment		Total cost of distribution	
		No. K.W.H. bought	No. K.W.H. sold	Amount paid for current	Per K.W.H. bought (cents)	Per K.W.H. sold (cents)	Amount paid	Per K.W.H. sold (cents)	Amount paid	Per K.W.H. sold (cents)	Amount paid	Per K.W.H. sold (cents)	Amount	Per K.W.H. sold (cents)
Ayer	$487.15	237,310	199,488	$5,353.31	2.256	2.683	$829	0.416	$860	0.431	$318	0.159	$2,007.44	1.006
Blackstone	....	147,584	109,819	5,882.47	3.986	5.356	414	.377	1,011	.920	7	.007	1,432.66	1.305
Franklin	....	917,590	577,180	15,200.56	1.657	2.634	1,332	.231	3,878	.672	478	.082	5,683.43	.985
Harvard	86.96	35,730	25,118	1,348.04	3.773	5.367	279	1.112	821	1.270	166	.661	766.65	3.052
Ludlow	....	246,959	185,421	5,797.52	2.348	3.196	419	.226	1,631	.880	28	.015	2,076.73	1.121
Manchester	50.00	267,900	191,929	11,990.93	4.476	6.248	...	....	229	.119	290	.151	519.57	.271
Milford	18.40	490,831	397,337	15,997.87	3.259	4.026	1,186	.298	1,982	.500	325	.082	3,492.52	.879
Mill River	....	110,810	90,822	1,662.15	1.500	1.830	804	.951	413	.455	11	.012	1,287.61	1.418
North Brookfield	....	260,184	218,022	5,770.92	2.168	2.647	423	.194	381	.175	15	.007	818.45	.375
Provincetown	356.06	112,668	86,988	3,943.33	3.500	4.533	842	.738	509	.585	21	.024	1,171.56	1.347
Randolph	4,822.47	424,600	347,861	13,401.98	3.156	3.853	803	.231	1,063	.305	....	....	1,865.57	.536
Shirley	....	72,225	45,920	2,889.00	4.000	6.291	53	.115	82	.178	....	....	135.01	.293
Spencer	131.33	79,720	70,179	3,109.06	3.900	4.430	51	.072	440	.627	110	.157	600.57	.856
Sunderland	....	29,444	21,582	1,177.76	4.000	5.457	48	.221	447	2.070	10	.046	504.55	2.338
Ware	100.02	468,749	386,179	16,249.51	3.467	4.208	1,178	.305	1,393	.361	9	.002	2,579.03	.668
Williamstown	1.30	359,133	267,183	5,386.99	1.500	2.016	284	.106	967	.362	240	.090	1,491.44	.558
Total	$6,053.69	4,267,437	3,221,028	$115,161.40	2.700	3.577	$8,805	0.270	$15,907	0.485	$2,023	0.063	$26,434.79	0.821
Average	....	266,715	201,314	....	....	....	....	....	....	....	....	....	....	....

OPERATING EXPENSES (*concluded*)

Municipality	Management and Miscellaneous																Total	
	General salaries		Salaries of board		General office expenses		Insurance		Law expenses		Bad debts		Rent of offices		All other expenses			
	Amount paid	Per K. W. H. "sold" (cents)	Amount paid	Per K. W. H. "sold" (cents)	Amount paid	Per K. W. H. "sold" (cents)	Amount paid	Per K. W. H. "sold" (cents)	Amount paid	Per K. W. H. "sold" (cents)	Amount lost	Per K. W. H. "sold" (cents)	Amount paid	Per K. W. H. "sold" (cents)	Amount paid	Per K. W. H. "sold" (cents)	Amount paid	Per K. W. H. "sold" (cents)
Ashburnham	$878	1.105	....	....	$85	0.112	$90	0.119	....	....	$13	0.018	....	....	$23	0.029	$3,817.15	5.069
Belmont	....	....	....	....	626	.218	537	.141	....	....	....	....	....	....	....	....	29,385.74	7.739
Boylston	....	....	....	....	22	.138	....	....	....	....	....	....	....	....	....	....	796.01	5.026
Georgetown	629	.887	....	....	70	.098	175	.247	....	....	....	....	....	....	25	.035	4,330.83	6.106
Groton	....	....	....	....	275	.491	75	.133	....	....	....	....	....	....	....	....	3,943.44	7.022
Groveland	600	.853	....	....	68	.097	....	....	....	....	....	....	....	....	....	....	4,267.48	6.065
Hingham	1,253	.347	....	....	575	.157	....	....	....	....	....	....	$156	0.043	200	.055	22,352.28	6.183
Holden	353	.575	....	....	77	.126	....	....	....	....	....	....	....	....	....	....	2,908.52	4.736
Littleton	....	....	....	....	92	.266	....	....	....	....	....	....	96	.280	....	....	2,975.55	8.602
Lunenburg	105	.531	....	....	124	.626	75	.379	....	....	....	....	....	....	....	....	1,312.57	6.635
Middleton	....	....	....	....	83	.413	68	.340	....	....	....	....	....	....	....	....	1,379.51	9.000
Norwood	1,739	.130	412	0.031	549	.049	175	.013	....	....	....	....	....	....	119	.009	25,518.85	2.679
Paxton	....	....	....	....	35	.249	346	2.420	....	....	....	....	....	....	....	....	1,092.76	7.639
Princeton	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1,204.13	4.590
Rowley	225	.705	....	....	70	.156	....	....	....	....	....	....	....	....	....	....	2,990.34	9.379
Shrewsbury	....	....	150	.114	139	.105	175	.132	....	....	109	.082	....	....	....	....	5,966.83	4.519
South Hadley	1,287	1.109	....	....	921	.527	555	.318	....	....	....	....	203	116	180	.101	16,046.40	9.184
Sterling	....	....	....	....	76	.126	....	....	....	....	....	....	....	....	....	....	2,227.54	3.702
Templeton	....	....	....	....	58	.069	18	.021	....	....	....	....	48	.056	....	....	5,320.35	6.261
Wellesley	450	.067	113	.017	1,034	.153	504	.075	....	....	....	....	180	.027	....	....	29,876.58	4.415
West Boylston	....	....	....	....	24	.036	....	....	....	....	....	....	....	....	....	....	2,983.20	4.379
Total — Norwood out	$6,420	0.265	$903	0.011	$4,720	0.194	$2,639	0.109	....	....	$122	0.005	$636	0.023	$427	0.018	$145,202.21	5.960
Total — Norwood in	8,163	.217	675	.018	5,369	.143	2,813	.075	....	....	....	....	683	.018	545	.015	180,821.06	4.812

Company	Management and Miscellaneous																				Total	
	General salaries		Directors' allowances		Salaries of officers		General office expenses		Insurance		Taxes		Law expenses		Bad debts		Rent of offices		All other expenses			
	Amount paid	Per K.W.H. sold (cents)	Amount paid	Per K.W.H. sold (cents)	Amount paid	Per K.W.H. sold (cents)	Amount paid	Per K.W.H. sold (cents)	Amount paid	Per K.W.H. sold (cents)	Amount paid	Per K.W.H. sold (cents)	Amount paid	Per K.W.H. sold (cents)	Amount lost	Per K.W.H. sold (cents)	Amount paid	Per K.W.H. sold (cents)	Amount paid	Per K.W.H. sold (cents)	Amount paid	Per K.W.H. sold (cents)
Ayer	$689	0.340	$230	0.115	$300	0.150	$1,584	0.764	$256	0.128	$842	0.422	$93	0.046	....	....	$108	0.560	$5	0.003	$11,955.04	5.993
Blackstone	210	.191	..	....	....	...	263	.212	98	.089	523	.476	31	.028	....	....	45	.041	....	....	8,454.93	7.699
Franklin	1,500	.260	45	.008	433	.075	1,140	.197	985	.160	1,196	.207	.	...	$30	0.007	552	.096	....	...	26,714.63	4.628
Harvard	165	.653	20	.080	150	.597	289	1,122	85	.138	151	.602	5	.020	.	....	32	.126	....	....	3,040.90	12.103
Ludlow	2,554	1.378	20	.011	792	.427	767	.418	66	.095	376	.203	....	....	19	.010	146	.079	....	...	12,616.10	6.804
Manchester	851	.443	....	....	3,600	1.876	841	.438	408	.210	1,792	.934	100	.052	....	....	..	.. .	6	.084	20,154.35	10.501
Milford	1,513	.881	320	.080	900	.326	3,872	.974	291	.073	2,139	.508	682	.172	....	....	515	.080	10	003	29,550.32	7.437
Mill River	122	.134	200	.220	800	.330	650	.716	53	.059	422	.465	5	.005	....	....	120	.132	....	....	4,822.40	5.310
North Brookfield	528	241	....	....	....	...	269	.123	114	.022	366	.168	45	.020	....	....	67	.031	....	....	7,974.92	3.658
Provincetown	1,458	1.676	....	....	....	....	579	.666	718	.826	755	.844	47	.054	....	....	71	.082	....	....	9,079.53	10.436
Randolph	409	.143	....	....	....	....	523	.150	621	.179	776	.223	38	.011	....	....	135	.039	....	.. .	23,682.50	6.521
Shirley	....	....	....	. ..	....	....	668	.809	80	.085	495	1.073	....	....	....	....	90	.106	....	....	4,004.90	8.719
Spencer	596	.563	26	.027	80	.114	873	1.945	226	.522	259	.369	61	.087	. ..	....	....	....	7	.010	5,768.12	8.254
Sunderland	....	...	....	....	....	....	262	1.078	5	.022	.60	.277	25	.116	....	....	....	.. .	....	....	2,008.51	9.268
Ware	972	.252	52	.014	....	....	460	.119	238	.074	1,791	.474	47	.012	....	....	380	.098	....	....	22,918.08	5.935
Williamstown	669	.250	180	.060	500	.168	1,888	.707	167	.063	1,230	.460	71	.027	....	....	185	.069	....	....	11,760.69	4.398
Total	$12,123	0.376	$1,073	0.034	$7,065	0.219	$14,560	0.438	$4,296	0.133	$13,152	0.410	$1,250	0.051	$58	0.002	$2,245	0.090	$28	0.001	$208,491.61	6.318

OPERATING INCOME (1914–1915)

Municipality	Lighting — commercial and domestic			Power			Other companies		
	No. K.W.H. sold	Amount received	Per K.W.H. sold (cents)	No. K.W.H. sold	Amount received	Per K.W.H. sold (cents)	No. K.W.H. sold	Amount received	Per K.W.H. sold (cents)
Ashburnham	88,835	$4,008	10.320	21,971	$923	4.230	....	....	....
Belmont	259,126	28,453	10.980	10,391	1.023	9.841	....	....	....
Boylston	7,243	914	12.620	(408)	(in lgt. sales)	?	....	....	....
Georgetown	22,426	2,719	12.120	(?) 21,392	1,406	6.573	(1,972)[2]	?	?
Groton	26,577	3,340	12.570	751	55	7.302	....	....	....
Groveland	30,645	3,367	10.986	905	74	8.205	....	....	....
Hingham	179,634	18,431	10.260	80,862	3,248	4.017	....	....	....
Holden	41,268	3,633	8.804	2,460	266	10.817	4,570	$137	3.000
Littleton	12,968	1,832	14.129	10,001	948	9.481	....	....	....
Lunenburg	11,569	1,466	12.672	2,077	139	6.693	....	....	....
Middleton	4,557	743	16.310	488	51	10.482	....	....	....
Norwood	336,061	27,476	8.152	823,073 (242,557)[1]	18,741 (3,476)[1]	2.277 (1.430)[1]	....	....	....
Paxton	7,865	1,018	12.944	2,136	181	8.461	....	....	....
Princeton	9,469	1,031	10.889	....	....	....	....	....	....
Rowley	14,941	2,333	15.616	3,008	439	14.006	....	....	....
Shrewsbury	65,937	7,345	10.949	2,113	106	5.000	....	....	....
South Hadley	81,530	10,220	12.535	19,860	1,436	7.231	440	15	3.500
Sterling	28,533	1,848	6.476	16,618	724	4.356	....	....	....
Templeton	49,909	5,878	11.978	6,042	432	7.128	....	....	....
Wellesley	359,302	31,372	8.731	113,203 24,761	1,245 1,277	1.100 5.157	....	....	....
West Boylston	27,598	2,998	10.862	....	....	....	....	....	....
Total — Norwood out	1,279,932	$132,949	10.387	339,039	$13,973	4.150	5,010	$152	3.050
Average	64,000	....	....	(225,836)	(12,728)	(5.635)[1]	....	....	....
Total — Norwood in	1,615,993	160,425	9.915	1,162,112	32,714	2.810	....	....	....

[1] Both Wellesley and Norwood sell power to the municipal pumping station at an extremely low figure. Both omitted.

[2] Sale included in power.

Company	Lighting — commercial and domestic			Power			Other companies		
	No. K. W. H. sold	Amount received	Per K.W.H. sold (cents)	No. K.W.H. sold	Amount received	Per K.W.H. sold (cents)	No. K.W.H. sold	Amount received	Per K.W.H. sold (cents)
Ayer	65,600	$10,112	15.414	28,963	$1,489	5.142	74,390	$2,257	3.034
Blackstone	36,349	4,886	13.392	25,456	1,321	5.188	....	....	....
Franklin	194,022	18,391	9.479	284,863	7,527	2.643	....	....	....
Harvard	10,618	1,809	17.042	5,604	426	7.603	....	....	....
Ludlow	78,063	8,257	10.577	60,104	2,590	4.309	4,793	240.65	5.020
Manchester	172,803	34,021	19.688	19,128	1,731	9.048	....	....	....
Milford	214,809	26,934	12.538	92,432	4,534	4.906	....	....	....
Mill River	24,935	3,718	14.911	54,080	1,834	3.392	....	....	....
North Brookfield	29,599	4,221	14.260	171,943	4,592	2.671	....	....	....
Provincetown	67,443	10,849	16.086	1,416	155	10.967	....	....	....
Randolph	148,587	13,970	9.309	151,825	5,705	3.758	....	....	....
Shirley	21,315	3,120	14.304	11,527	560	4.860	....	....	....
Spencer	21,559	3,250	15.076	5,320	435	8.183	....	....	....
Sunderland	10,372	1,467	14.140	3,309	204	6.025	....	....	....
Ware	167,834	18,741	11.166	68,766	3,424	4.980	....	....	....
Williamstown	190,904	17,061	8.937	23,360[1]	1,016	4.344	....	....	....
Total	1,455,310	$180,809	12.418	1,006,228	$37,545	3.754	79,183	$2,497.65	3.160

[1] Includes 8,000 K.W.H. for heating.

OPERATING INCOME (1914–1915)

Municipality	Lighting — commercial and domestic			Power			Other companies		
	No. K.W.H. sold	Amount received	Per K.W.H. sold (cents)	No. K.W.H. sold	Amount received	Per K.W.H. sold (cents)	No. K.W.H. sold	Amount received	Per K.W.H. sold (cents)
Ashburnham	38,835	$4,006	10.320	21,971	$923	4.230	....	....	....
Belmont	259,126	28,453	10.980	10,391	1,022	9.841	....	....	....
Boylston	7,243	914	12.620	(406)	(in lgt. sales)	†	....	....	....
Georgetown	22,426	2,719	12.120	(†) 21,392	1,400	6.578	(1,972)[2]	†	†
Groton	26,577	3,340	12.570	751	55	7.302	....	....	....
Groveland	30,645	3,367	10.986	905	74	8.205	....	....	....
Hingham	179,634	18,431	10.260	80,862	3,248	4.017	....	....	....
Holden	41,266	3,633	8.804	2,400	266	10.817	4,570	$137	3.000
Littleton	12,968	1,832	14.128	10,001	948	9.481	....	....	....
Lunenburg	11,569	1,466	12.672	2,077	139	6.623	....	....	....
Middleton	4,557	743	16.310	488	51	10.432	....	....	....
Norwood	336,061	27,476	8.152	323,073 (342,557)[1]	18,741 (5,476)[1]	2.577 (1.430)[1]	....	....	....
Paxton	7,805	1,018	12.944	2,126	181	8.461	....	....	....
Princeton	9,469	1,031	10.889	....	....	....	....	....	....
Rowley	14,941	2,333	15.616	3,006	439	14.606	....	....	....
Shrewsbury	65,937	7,345	10.949	2,113	106	5.000	....	....	....
South Hadley	81,530	10,220	12.536	19,860	1,436	7.231	440	15	3.500
Sterling	28,533	1,849	6.476	16,615	724	4.355	....	....	....
Templeton	49,909	5,578	11.978	6,042	432	7.128	....	....	....
Wellesley	359,202	31,372	8.731	113,203 } [1] 24,761 }	1,245 } 1,377 }	1.100 } 5.157 }	....	....	....
West Boylston	27,598	2,998	10.862	....	....	....	....	....	....
Total — Norwood out	1,279,932	$132,949	10.387	389,089	$18,973	4.150	5,010	$152	3.050
Average	64,000	....	....	(225,836)	(12,738)	(5.635)[1]	....	....	....
Total — Norwood in	1,615,993	160,425	9.915	1,102,112	33,714	2.810	....	....	....

[1] Both Wellesley and Norwood sell power to the municipal pumping station at an extremely low figure. Both omitted. † Sale included in power.

Company	*Lighting — commercial and domestic*			*Power*			*Other companies*		
	No. K. W. H. sold	*Amount received*	*Per K.W.H. sold (cents)*	*No. K.W.H. sold*	*Amount received*	*Per K.W.H. sold (cents)*	*No. K.W.H. sold*	*Amount received*	*Per K.W.H. sold (cents)*
Ayer	65,800	$10,112	15.414	28,968	$1,499	5.142	74,380	$2,257	3.034
Blackstone	30,349	4,886	13.392	25,456	1,321	5.188	....	....	....
Franklin	194,022	16,391	9.479	284,863	7,527	2.643	....	....	....
Harvard	10,616	1,809	17.042	5,604	426	7.603	....	....	....
Ludlow	78,063	8,257	10.577	60,104	2,590	4.309	4,793	240.65	5.000
Manchester	172,803	34,021	19.688	19,126	1,731	9.048	....	....	....
Milford	214,809	26,934	12.538	92,432	4,534	4.905	....	....	....
Mill River	24,935	3,718	14.911	54,060	1,834	3.392	....	....	....
North Brookfield	29,599	4,221	14.260	171,943	4,593	2.671	....	....	....
Provincetown	67,443	10,849	16.086	1,416	155	10.967	....	....	....
Randolph	148,587	13,970	9.300	151,825	5,705	3.758	....	....	....
Shirley	21,815	3,120	14.304	11,527	560	4.860	....	....	....
Spencer	21,539	3,250	15.076	5,320	435	8.183	....	....	....
Sunderland	10,372	1,467	14.140	3,399	204	6.025	....	....	....
Ware	167,834	18,741	11.166	68,766	3,424	4.980	....	....	....
Williamstown	190,904	17,061	8.937	23,399[1]	1,016	4.344	....	....	....
Total	1,455,310	$190,809	12.418	1,006,223	$37,546	3.764	79,183	$2,497.65	3.160

[1] Includes 8,000 K.W.H. for heating.

OPERATING INCOME (*concluded*)

Municipality	Municipal buildings			Other operating income	Total operating income			No. K.W.H. supplied for street lights
	No. K.W.Hs. supplied	Amount charged	Per K.W.H. supplied (cents)		No. K.W.Hs. sold	Amount received	Per K.W.H. sold (cents)	
Ashburnham	1,343	$160	11.928	$120	62,149	$5,211.49	8.385	13,160
Belmont	5,582	585	10.471	....	275,101	30,059.64	10.900	104,607
Boylston	602	72	12.027	....	7,845	986.43	12.574	8,031
Georgetown	1,176	132	11.251	....	44,994	4,257.48	9.462	25,936
Groton	3,085	356	11.542	....	30,413	3,751.06	12.334	25,746
Groveland	631	83	13.111	....	32,181	3,523.60	10.949	38,159
Hingham	3,647	386	10.592	....	264,143	22,065.81	8.354	97,369
Holden	2,140	248	11.582	....	50,438	4,284.48	8.495	10,973
Littleton	1,225	166	13.513	....	24,194	2,945.91	12.173	10,407
Lunenburg	318	38	12.000	....	13,964	1,642.95	11.765	5,816
Middleton	788	118	15.000	....	5,833	912.57	15.645	9,393
Norwood	8,306	620	7.458	795	1,167,442	47,632.29	4.080	162,140
Paxton	464	37	8.000	....	10,465	1,235.90	11.810	3,840
Princeton	(20)	?	?	....	9,469	1,031.12	10.889	18,152
Rowley	838	121	14.383	....	18,787	2,893.09	15.400	13,126
Shrewsbury	4,000	242	6.060	....	72,050	7,693.50	10.681	60,000
South Hadley	2,416	313	12.959	....	104,246	11,984.26	11.496	70,477
Sterling	803	76	9.500	169	45,954	2,816.92	6.130	14,220
Templeton	748	82	11.000	....	56,699	6,391.91	11.273	28,280
Wellesley	12,425	786	6.324	....	509,691	34,679.42	6.804	164,791
West Boylston	2,103	167	7.952	23	29,701	3,188.14	10.734	38,420
Total — Norwood out	44,334	$4,169	9.400	$312	1,667,315	$151,555.68	9.090	760,903
Total — Norwood in	52,642	4,789	9.097	$1,107	2,824,770	199,187.97	7.050	923,043

OPERATING INCOME (*concluded*)

Company	Public street lighting			Other operating income	Total operating income		
	No. K.W.H. sold	Amount received	Per K.W.H. sold (cents)		No. K.W.H. sold	Amount received	Per K.W.H. sold (cents)
Ayer	30,530	$3,324	10.887	....	198,488	$17,182.17	8.613
Blackstone	48,014	5,104	10.631	$24	109,819	11,337.41	10.324
Franklin	98,295	6,337	6.447	....	577,180	32,256.03	5.589
Harvard	8,898	1,007	11.312	1,239	25,118	4,480.47	17.838
Ludlow	42,461	3,199	7.534	....	185,421	14,285.42	7.720
Manchester	....	....	....	....	191,929	35,751.70	18.628
Milford	90,096	8,919	9.900	....	397,337	40,386.82	10.162
Mill River	11,807	1,721	14.576	....	90,822	7,273.16	8.008
North Brookfield	16,480	1,784	10.823	409	218,022	11,006.03	5.048
Provincetown	18,129	2,311	12.748	49	86,968	13,364.95	15.364
Randolph	47,449	5,866	12.363	144	347,861	25,679.39	7.382
Shirley	12,578	1,461	11.615	235	45,920	5,376.74	11.709
Spencer	43,300	5,166	11.931	82	70,179	8,933.55	12.730
Sunderland	7,811	525	6.721	....	21,582	2,195.91	10.175
Ware	149,579	9,621	6.432	4,496	386,179	36,282.33	9.395
Williamstown	51,880	3,691	7.115	....	267,183	21,769.33	8.148
Total	677,307	$60,032	8.870	$6,678	3,221,026	$287,561.41	8.928

NET INCOME AND CHARGES AGAINST INCOME — ACTUAL AND ESTIMATED
(1914–1915)

Municipality	Apparent results of operation		Other items of income (Profit and loss)	Depreciation		Interest			
						Actually paid		On total investment	
	Gain	Loss		Amount	Per K.W.H. "sold"	Amount	Per K.W.H. "sold"	Amount (@ 4%)	Per K.W.H. "sold"
Ashburnham	$1,394.34	....	....	$502.86	0.668	$353.69	0.470	$733	1.000
Belmont	673.90	....	....	1,651.00	.435	931.25	.245	2,282	.600
Boylston	188.42	....	$21.73	345.55	2.177	312.06	1.966	471	3.000
Georgetown	....	$73.35	....	568.50	.801	726.67	1.024	798	1.125
Groton	....	192.38	....	726.76	1.294	305.17	.543	1,041	1.860
Groveland	....	763.88	....	526.50	.748	523.13	.744	695	.990
Hingham	....	286.47	1,094.70	1,821.99	.540	....	....	2,866	.793
Holden	1,375.96	....	3.84	617.00	1.001	368.16	.600	907	1.150
Littleton	....	30.64	61.34	625.12	1.812	604.29	1.746	872	2.500
Lunenburg	330.38	....	6.00	(480.00)	(2.426)	429.72	2.172	656	3.250
Middleton	....	466.94	....	162.59	1.068	211.64	1.390	270	1.400
Norwood	12,013.44	....	256.83	2,635.02	.196	1,354.22	.102	3,928	.300
Paxton	143.14	....	?	150.00	1.049	190.00	1.328	314	2.240
Princeton	....	173.01	....	750.00	2.815	545.00	2.046	667	2.500
Rowley	....	97.25	....	567.00	1.777	495.23	1.552	858	2.689
Shrewsbury	1,726.67	....	?	1,393.46	1.055	715.61	.542	1,969	1.415
South Hadley	....	4,062.14	443.68	1,009.00	.572	800.00	.458	1,422 (1,600)[2]	.810
Sterling	589.38	....	....	487.32	.810	503.60	.837	792	1.317
Templeton	1,071.56	....	....	958.29	1.128	661.73	.779	1,308	1.539
Wellesley	4,800.84	....	....	2,530.00 (?)(783.88)	.375	260.00	.038	3,361	.500
West Boylston	204.94	....	....	721.83	1.060	397.90	.584	1,037	1.523
Total — Norwood out.	$12,499.53[1]	$6,146.06	$1,631.29	$16,105.77	0.661	$9,344.85	0.389	$23,180	0.954
Total — Norwood in.	24,512.97	....	1,888.12	18,740.29	.501	10,689.07	.284	27,108	.720

[1] Net income, losses deducted, $6,353.47, equal to 0.270 cents per K.W.H. delivered, or 0.380 cents per K.W.H. actually sold.
[2] Interest on bonds outstanding.

Company	Net operating income		Other items of income (Profit and loss)	Depreciation		Interest		Dividends			Other charges against income	Balance	
	Amount	Per K.W.H. sold		Amount	Per K.W.H. sold	Amount paid	Per K.W.H. sold	Amount paid	Rate (per cent)	Per K.W.H. sold		Surplus	Deficit
Ayer	$5,227.13	2.620	$541.66	$1,906.00	0.955	$2,049.44	1.027	$2,400	8	1.203	$186.18	....	$772.83
Blackstone	2,382.48	2.625	274.38	375.00	.341	377.60[3]	.344	2,352[4]	8	2.142	72.66	....	20.40
Franklin	5,541.40	0.961	3,689.61	2,166.75	.375	1,280.22	.220	2,800	7	.485	1,689.39	$1,244.64	157.77
Harvard	1,429.57	5.782	77.47	....	....	1,588.24	6.328	....	....	....	66.57	....	3,229.40
Ludlow	1,669.32	0.915	56.52	4,175.52	2.252	169.32	.091	....	....	....	610.40	....	1,806.98
Manchester	15,597.35	8.127	968.79	....	....	2,589.32	1.349	15,775	10	8.219	8.75	....	1,683.21
Milford	10,885.90	2.725	1,187.59	5,809.57	1.462	4,127.31	1.039	2,800	7	.705	969.82	....	....
Mill River	2,450.76	2.698	161.26	620.57	.683	1,308.14	1.440	600	4	.661	68.50	19.81	....
North Brookfield	3,031.11	1.390	505.94	....	....	9.50	.004	3,000	5	1.376	295.20	242.35	....
Provincetown	4,285.42	4.928	771.02	....	....	592.52	.681	4,000	8	4.598	81.97	881.95	....
Randolph	2,996.89	0.861	1,680.77	....	....	2,367.65	.681	1,400	8½	.402	291.12	618.89	....
Shirley	1,371.75	2.990	100.00	447.44	.974	515.23	1.122	509	10	1.109	....	....	241.00
Spencer	3,165.43	4.476	(?) 145.00	1,213.26	1.729	1,407.72[3]	2.006	609[4]	2	.864	(?)324.00	....	....
Sunderland	192.40	0.392	....	....	....	95.70	.429	....	....	....	....	96.70	....
Ware	13,364.25	3.460	1,537.96	850.00	.220	4,944.64	1.280	8,070	7½	2.090	246.67	790.90	....
Williamstown	10,018.64	3.750	(?) 819.00	....	....	879.71[3]	.329	7,344[4]	20	2.748	(?)445.00	1 668.98	....
Total	$84,069.80	2.610	$11,917.97	$17,565.11	0.545	$24,302.27	0.755	$51,656	7.4	1.600	$5,241.22	$5,064.17	$8,041.54
	(24,068.13)[1]	(0.946)[1]							(4.4)[5]				

[1] Street lighting income deducted. [2] Mostly jobbing. [3] Computed as that proportion of total interest paid, which the cost of electric plant bears to the combined cost of gas and electric plants, — 54.4, 24.1, and 42.4 per cent respectively. [4] Computed as that proportion of total dividends paid which net earnings of electric plant bear to the combined net income of both gas and electric plants, — 73.5, 31.1 and 21.8 per cent respectively.
[5] On capital and loans.

Municipality	*Taxes lost by municipality (@ 0.410 cents per K.W.H. "sold")*	*Other charges incurred*	*Total charges against income including interest on entire investment and taxes lost*	*Cost of street lighting*				*Additional interest which would be paid by companies of same size*	
				Amount[1] *(total loss)*	*Number K.W.H. used*	*Per K.W.H. (cents)*	*Divergence from av. street lighting rate of companies (5.870 cents)*	*Amount @ 1½% on total investment*	*Per K.W.H. used for street lighting (cents)*
Ashburnham	$309	....	$1,544.86	$150.52	13,160	1.140	−7.730	$300	2.280
Belmont	1,970	....	5,909.00	5,235.10	104,607	5.009	−3.870	919	0.880
Boylston	65	....	881.55	671.40	8,031	8.400	−0.470	162	2.017
Georgetown	280	....	1,646.50	1,719.85	25,936	6.615	−2.255	330	1.272
Groton	230	....	1,207.76	2,190.14	25,746	8.425	−0.445	351	1.363
Groveland	288	$33.44	1,542.94	2,306.82	33,159	6.070	−2.800	273	0.715
Hingham	1,430	9.40	6,177.39	5,309.16	97,389	5.530	−3.340	1,075	1.104
Holden	252	....	1,774.00	394.20	10,975	3.595	−5.295	283	2.580
Littleton	142	28.23	1,669.35	1,638.65	10,407	15.300	+7.530	273	2.621
Lunenburg	81	....	737.00	370.62	5,816	6.400	−2.270	240	4.126
			(1,217)[1]	(850.62)[2]		(14.630)	(+5.810)		
Middleton	63	....	495.59	962.53	9,323	10.240	+1.370	90	0.958
Norwood	5,450	1.72	12,014.74	[3]255.53	162,140	Gain	Gain	1,945	0.768
Paxton	59	....	523.00	379.86	3,840	9.900	+1.030	120	3.125
Princeton	109	....	1,526.00	2,099.01	16,172	9.440	+0.576	260	1.431
Rowley	130	....	1,555.00	1,652.25	13,126	12.710	+3.840	322	2.453
Shrewsbury	541	....	3,803.46	2,076.79	60,000	3.460	−5.410	701	1.168
South Hadley	717	....	3,130.00	6,767.46	70,477	9.500	+0.630	600	0.851
			(3,317)	(6,935.46)		2.340	(+0.970)		
Sterling	247	....	1,526.32	926.94	14,220	6.000	−2.270	297	2.089
Templeton	343	21.24	2,535.53	1,563.97	28,280	5.566	−3.295	491	1.736
Wellesley	2,762	....	8,653.00	3,852.16	164,791	2.336	−6.435	1,284	0.779
West Boylston	280	....	2,088.83	1,833.89	38,490	4.800	−4.070	390	1.015
Total — Norwood out	$9,983	$92.31	$49,342.80	$41,358.40	760,923	5.435	−3.435	$8,661	1.138
Total — Norwood in	15,413	94.03	61,357.54	41,102.87	923,063	4.450	−4.420	9,906	1.073

[1] With depreciation (first year of operation). [2] The difference between all available income, if any, and the charges against income, actual and estimated as above. No allowance made for free quarters. Operating deficit is included. [3] Gain.

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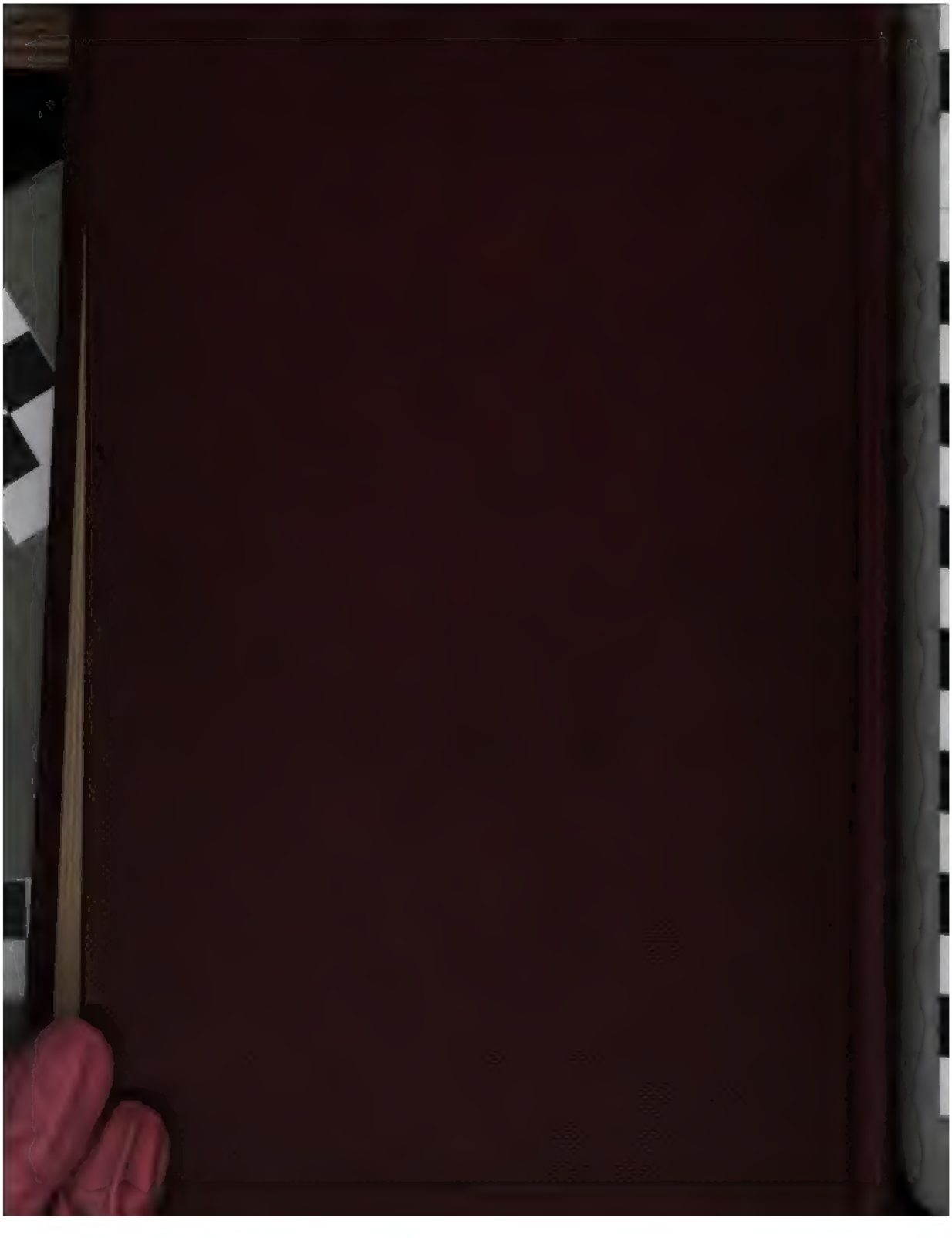
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